

# Scratch

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ISBN: 9781311866912

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### **Description.**

The goal of the book is introduction into programming, mathematics, sciences for 7-10 students.

The material is written for student self-study for Grade 7 : students who have basic skills of operating a computer. Children have to be able to use «a mouse», start using labels, etc., as well as count to 480, multiply and divide. More complex mathematical notions (negative numbers, decimal fractions, coordinate axis, degrees) will be explained on the pages of the book.

Scratch is a new free programming environment that allows children from 7 years old to create their own stories, cartoons, games and other creation.

This program allows children to express themselves in computer creative work. Scratch was specifically created as a new learning environment for teaching school students programming.

You can create cartoons in Scratch, play with various objects, change them, move them on the screen, set up forms of interaction between objects. The programs are created of multi-colored blocks the same way as Lego construction sets are made of multi-colored bricks.

Scratch was created in 2006 under the supervision of Mitchel Resnick by a Lifelong Kindergarten group in MIT Media Lab.

Scratch works on Windows or Linux computers. It doesn't work on any tablets!

Each chapter requires about 20-30 minutes to study. It is not recommended to study more than two chapters per day.

You can ask questions to authors by:

[scratch.book@ya.ru](mailto:scratch.book@ya.ru)

<http://facebook.com/ScratchBook4u>

[www.indiegogo.com](http://www.indiegogo.com) started on a project to translate the book into Spanish.

### **[Introduction. For parents. How to download and install Scratch.](#)**

The program Scratch is downloaded for free from the Internet at [http://info.scratch.mit.edu/ru/Scratch\\_1.4\\_Download](http://info.scratch.mit.edu/ru/Scratch_1.4_Download) (version 1.4). This is not the latest version of Scratch,

however, it has everything necessary for interesting work and does not require an Internet connection. Version 2.0 works online in the browser and requires constant Internet connection.

Installing the program is as easy as can be.

We download the file ScratchInstaller1.4.exe from the provided link, we don't need to check for viruses, as this source is reliable.

We start ScratchInstaller1.4.exe and press «Next» several times (or «Continue»). By default, the program will install into the Program Files folder, and will create a folder called «Scratch Projects» in «My documents», that is where the created programs will be located. There will appear an icon on the desktop.

Parents are free. Come back in an hour, get the child off the computer, let him run around. If the child wants to continue his learning right away, he has to do no less than 100 squats.

## Chapter 1. How Scratch is built. The first program.

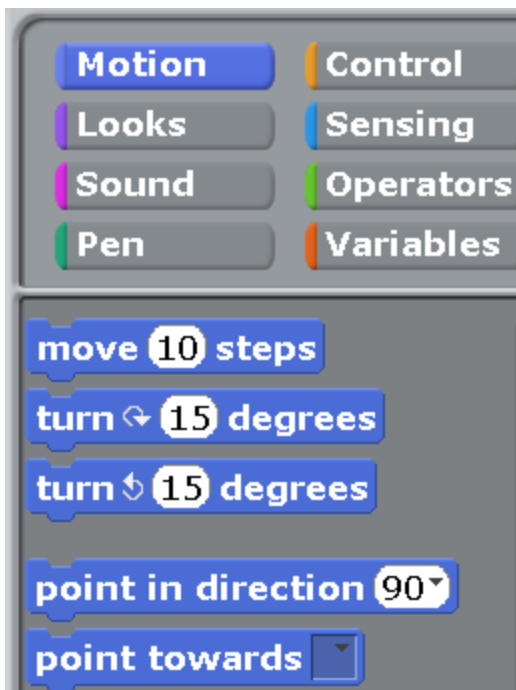
Start Scratch from your icon on the desktop.

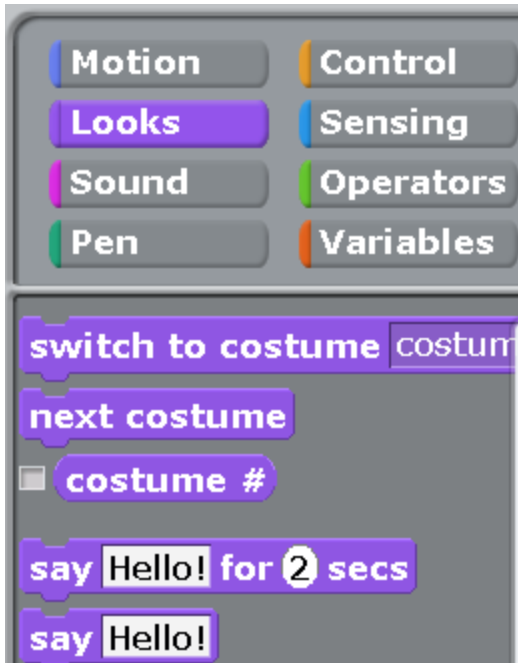


Press the square in the top right corner in order to expand Scratch to take up the whole screen. Now you can see very well that Scratch has three parts. There is a bunch of blue blocks on the left. The program will be working on the white background on the right. There is empty space in the middle, that is where we are going to put together a program of blocks, that is our working area.

Scratch has many blocks of different colors. We will be mainly using the navy blue, yellow, violet and light blue blocks.

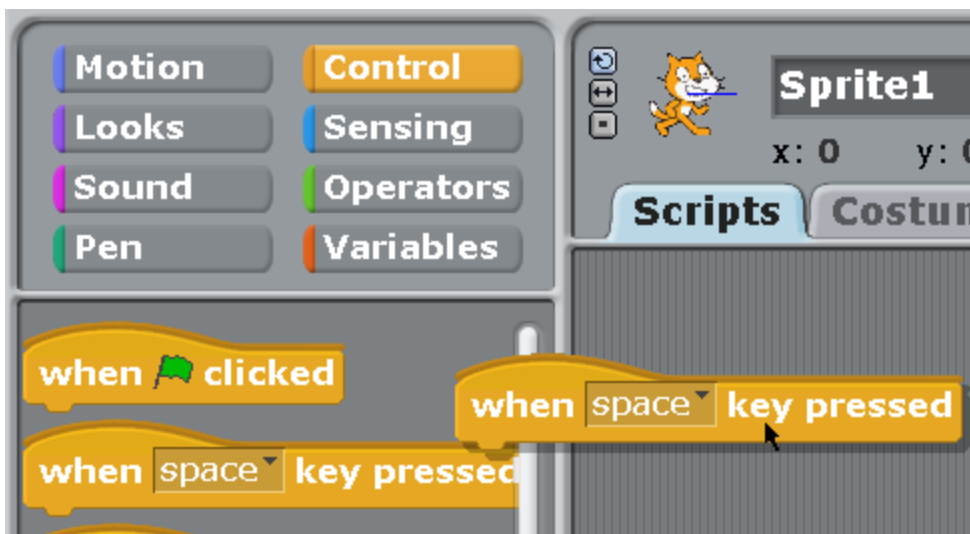
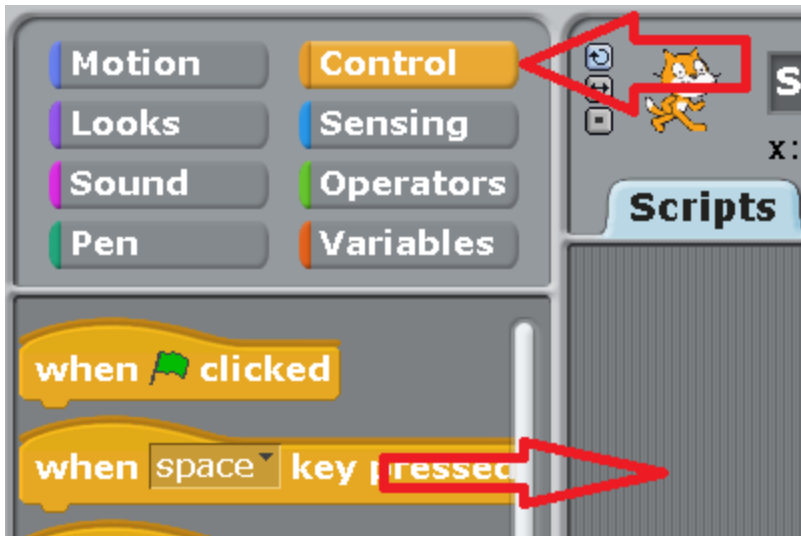
Click your mouse on the names of blocks on the left at the top.



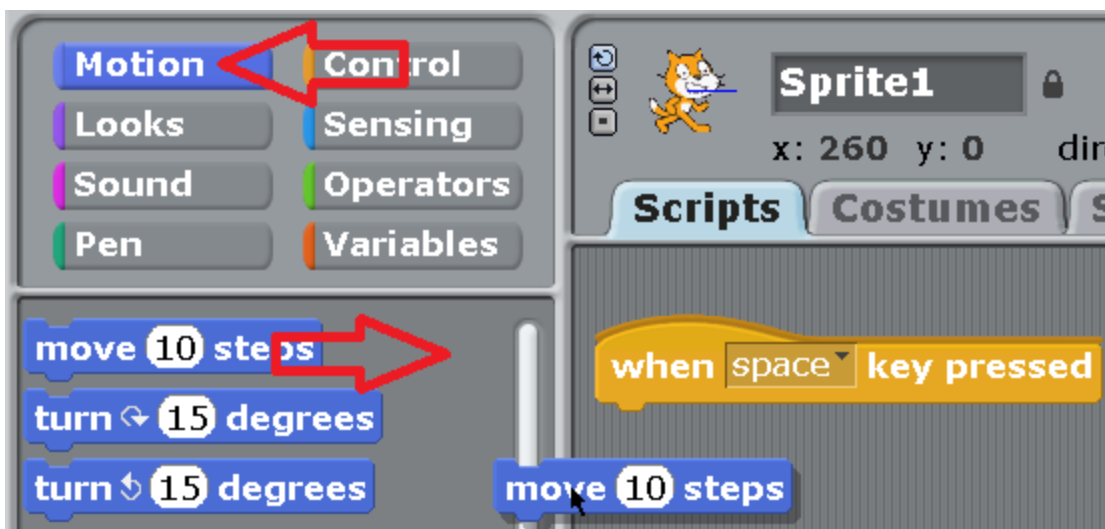


Now it is time to teach a cat how to run.

Let us choose the yellow «control» blocks at the top and drag the block «when space key pressed» to the center of the screen. In order to drag a block you need to click with your mouse on it and then drag, and not just click on it.



We choose the navy blue blocks on the left called «motion» and drag the block «move 10 steps» to the center of the screen, and there we attach it under the yellow block «when space key pressed».



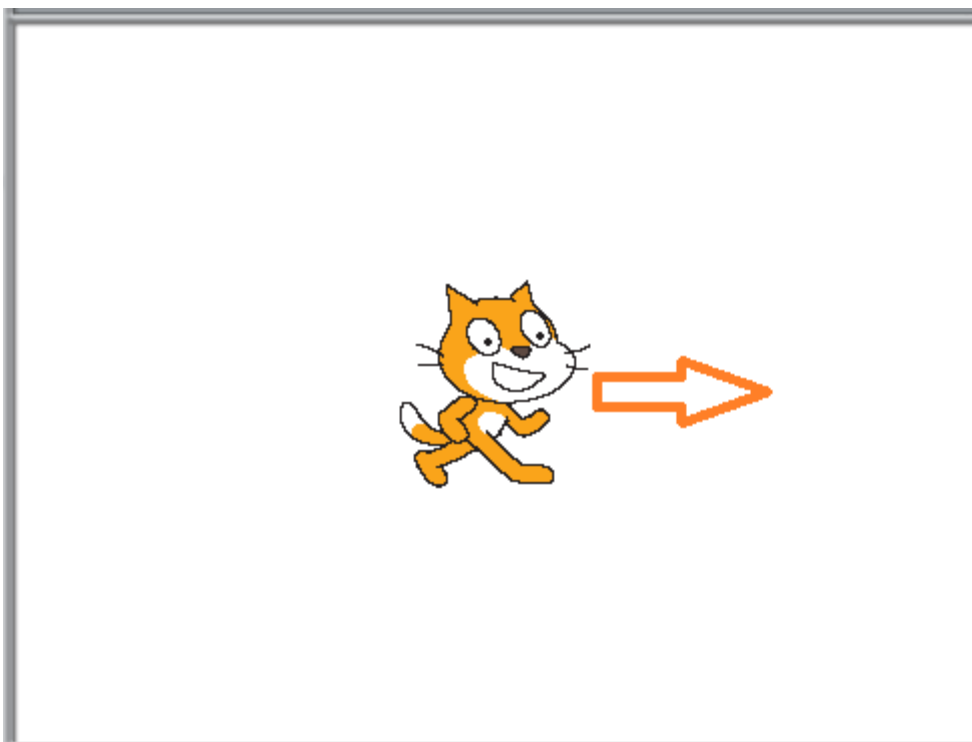
When the navy blue block wants to attach to the yellow one, a white stripe appears. Release the mouse button, and it will attach.



Hooray! We've got the first program!



Press the space bar and look at how the cat is moving.



If you press it for a long time, it will get to the end of the screen and will almost completely hide. You will only see its tail sticking out.



That is what we are going to pull it out by! Press on the tail and drag the cat to the center of the screen. Press on the space bar again and the cat is going to go to the right again. Now drag it to the left part of the screen and answer the question: how many times do you need to press the space bar to make the cat reach the right side of the screen?

I managed to press it 40 times. Forty times ten steps is 400

So, the screen is about 400 steps wide. Remember this number.

As you can see from the top picture, the cat has some sort of a wrong name, «Sprite1».



Click on it with a mouse and write a normal cat name - «Cat».



Let us add the sound «meow» to the program. Press the fuchsia colored blocks «sound» and drag the block «play sound meow» under the blue block «move 10 steps».



Now, when pressing the bar, the Cat walks and meows.

If he meows too loudly, regulate the sound, for example, by pressing on the icon of sound volume in the right bottom corner of Windows.

Then move the regulator of sound lower.



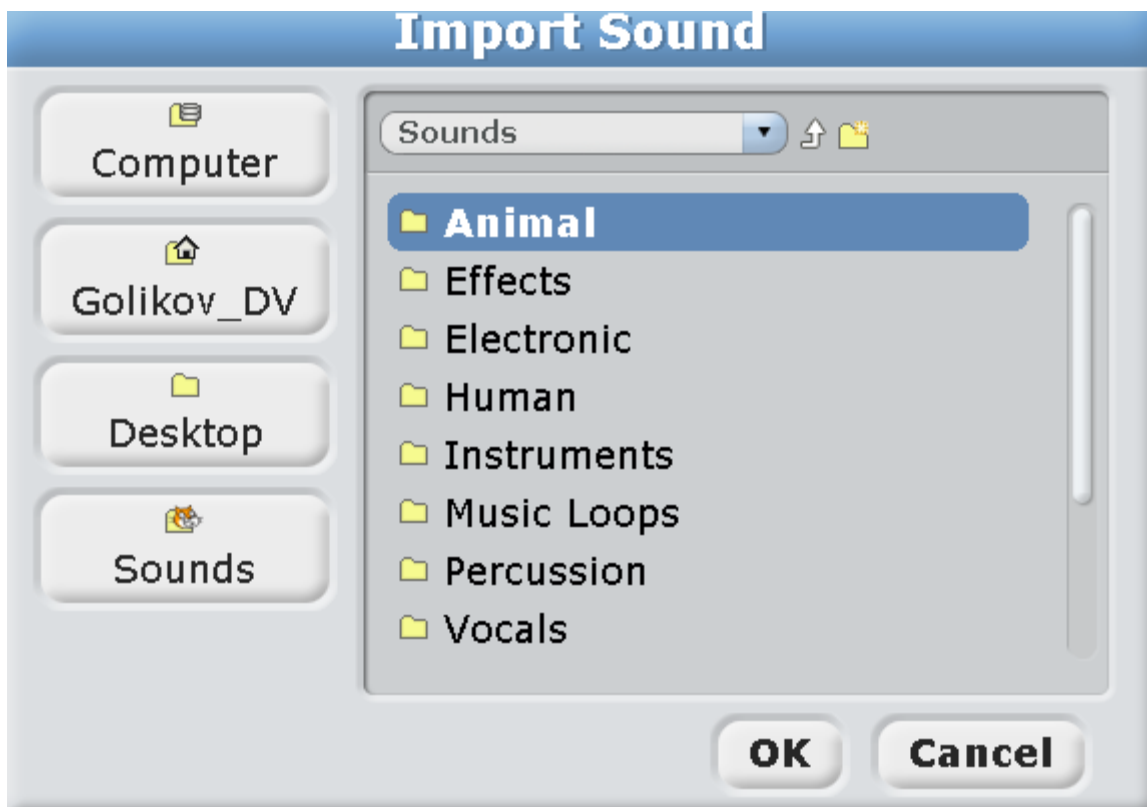
If you are tired of meowing, you can add new sounds for the cat. Let him bark, for example!

You need to press on the tab «Sounds», and then the button «import».



The window of «sound import» will open up.

There are several folders there. Go to the «Animal» folder.



There is a big list of animal sounds in the folder. When pressing the sound file, it sounds. Press on different files, listen to the sounds. Choose the sound «Dog1» and press on «OK».

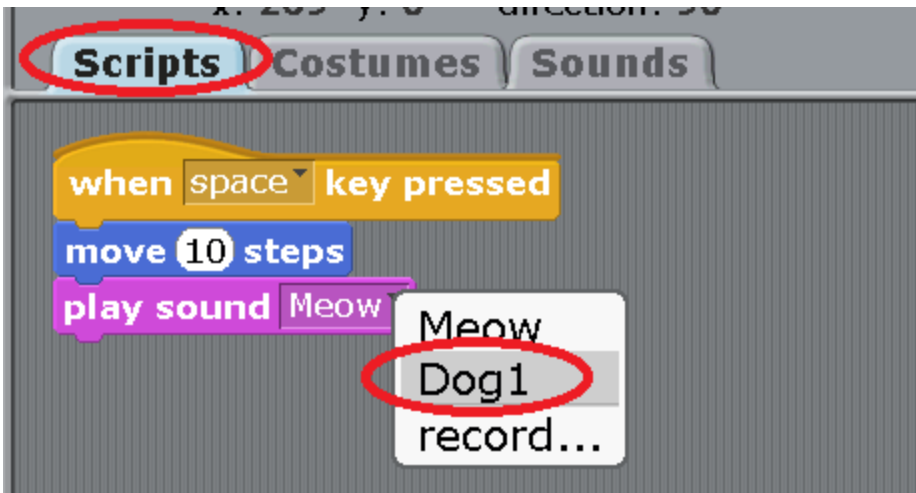




Now the Cat can use two different sounds in the program.



Press on the tab «scripts» and then on the triangle in the block «play sound meow», and choose the sound «Dog1».



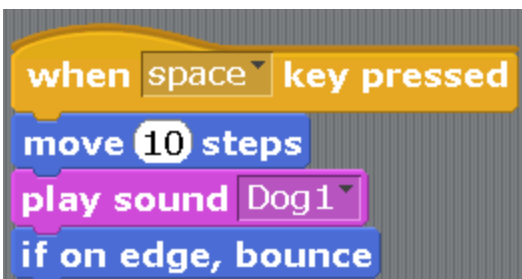
This is the program that you get. Press the space bar, the Cat is walking and barking!



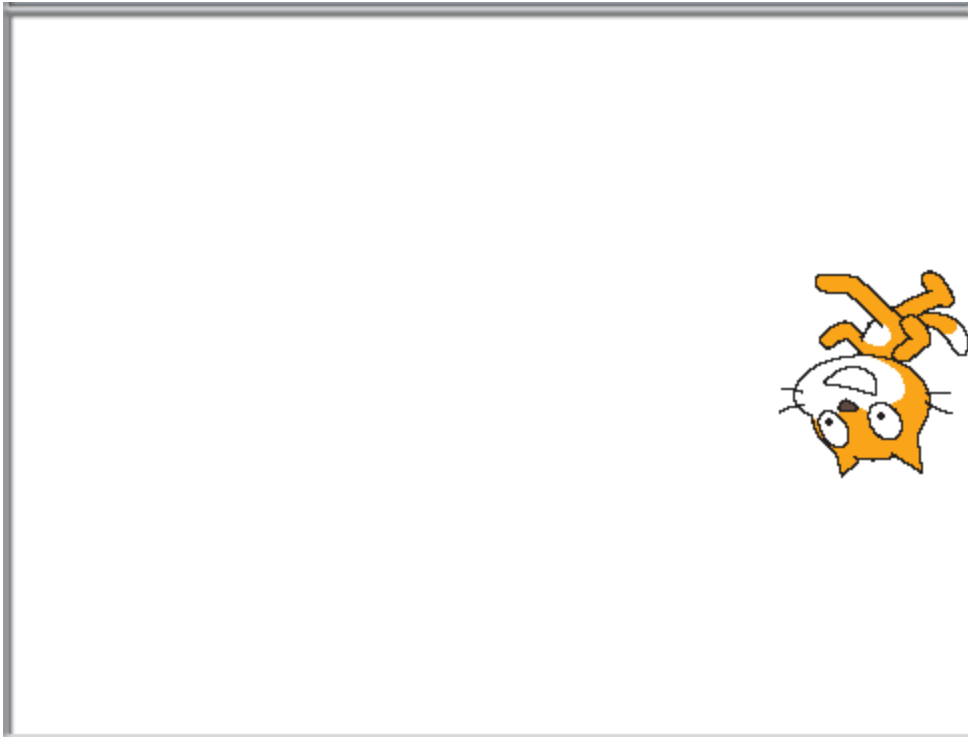
Practice adding different sounds.

## [Chapter 2. Making the first program more expanded.](#)

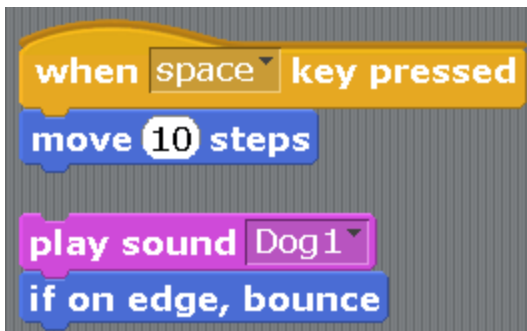
You are probably too tired of dragging the Cat out of the corner of the screen every time. Let us add the blue block «if on edge, bounce».



Now the Cat gets to the edge of the screen and bounces.



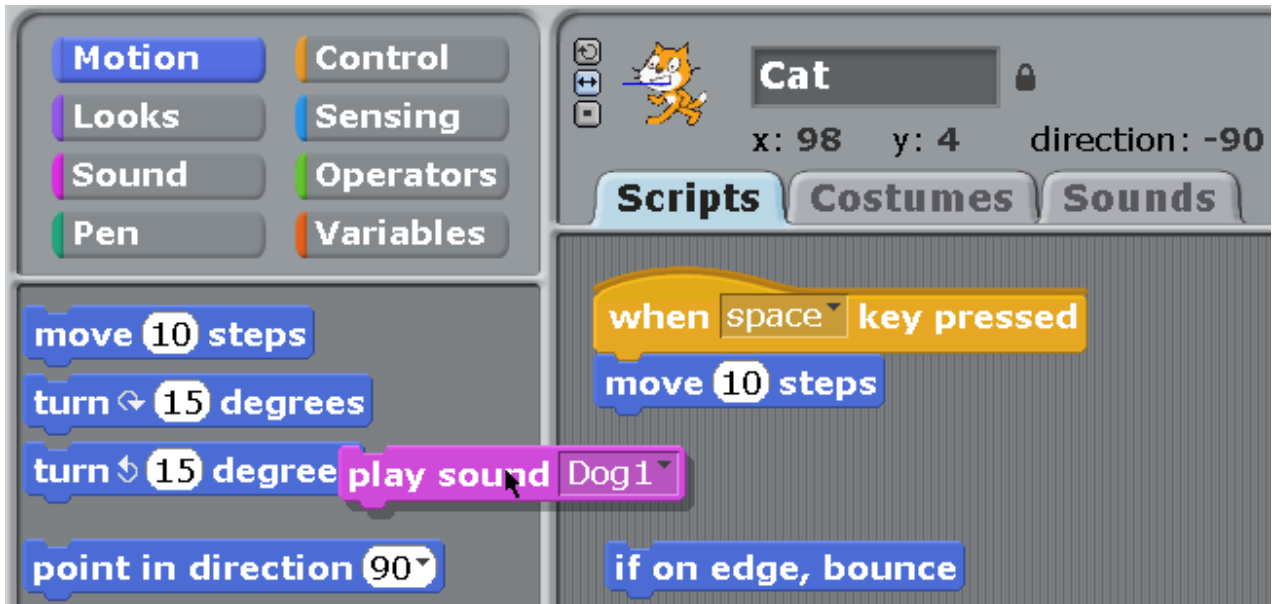
If you are tired of the endless barking of the Cat, you can delete the fuchsia colored block «play sound Dog1». For that we first press on it, and drag it a bit lower and release. Two lower blocks are disconnected.



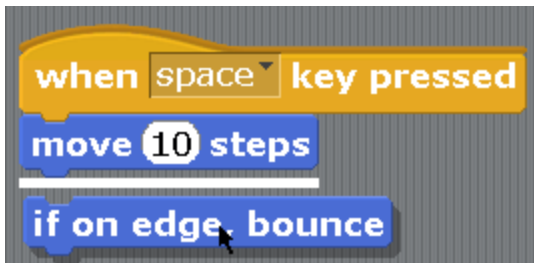
Now let us disconnect the lower block. Let us press on it and drag it down.



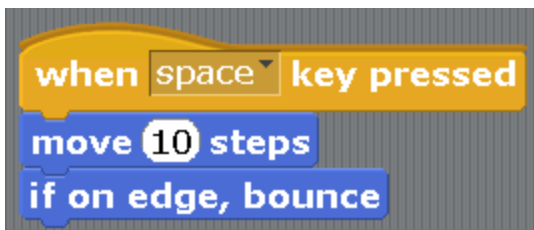
Then we drag the fuchsia block to the left part of the screen where all the blocks are, and drop it there. It will disappear.



Then we just attach the block «if on edge, bounce» back to the program.



You will get a program of the Cat's movement without any sound.



If you hold the space bar, the Cat will continuously run left and right and roll over. Try to change the program a little. Instead of number 10, write number 1 into the block «move 10 steps». To do that quickly, press twice on number 10 and it will turn blue. Press 1 and then pres Enter.



If you hold the space bar now, the Cat will be running slower! Of course, he only makes 1 small step each time. Now you can play around and type in different numbers there that you like. Watch the Cat's behaviour when pressing the space bar.



```
when space key pressed
  move 10 steps
  if on edge, bounce
  say Hello!
```

Now the Cat is running and screaming «Hello!» on his way. Change the word «Hello!» to something else. The Cat will be saying your words.

Now add a violet block «change color effect by 25» at the bottom.

```
when space key pressed
  move 10 steps
  if on edge, bounce
  say Hello!
  change color effect by 25
```

The Cat is running and changing the color! The color changes very quickly. Change number 25 to 1. The color change will be smoother.

The color effect can be changed to another effect. To do that, press on the triangle near the word «color». A drop-down list of effects will appear. Choose any. Now you can play around choosing different effects and putting different speeds of change. Do not put more than 25, that is not very interesting.

Guess which 2 effects did we use for the Cat in turn?



And what effects were used now?



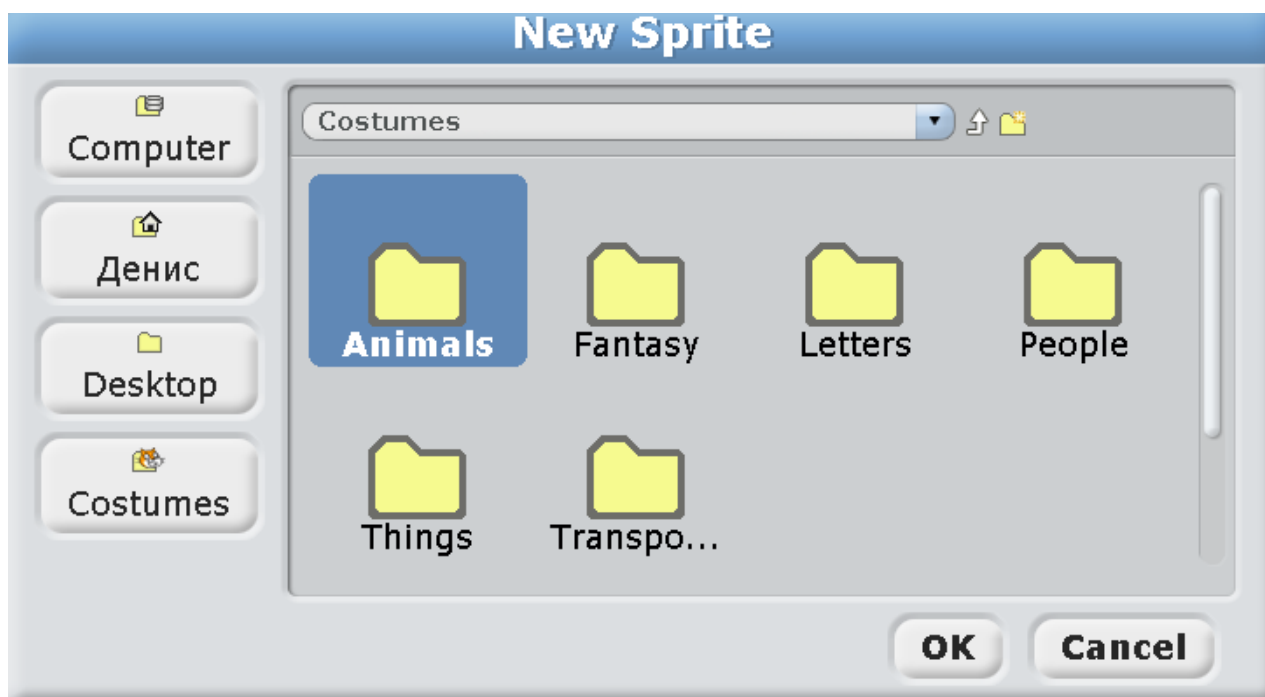
And now?



Well, that's enough, let's stop torturing the Cat. Let's make it a friend and add a new character in the program. There is an interesting button for that — a folder with a star.



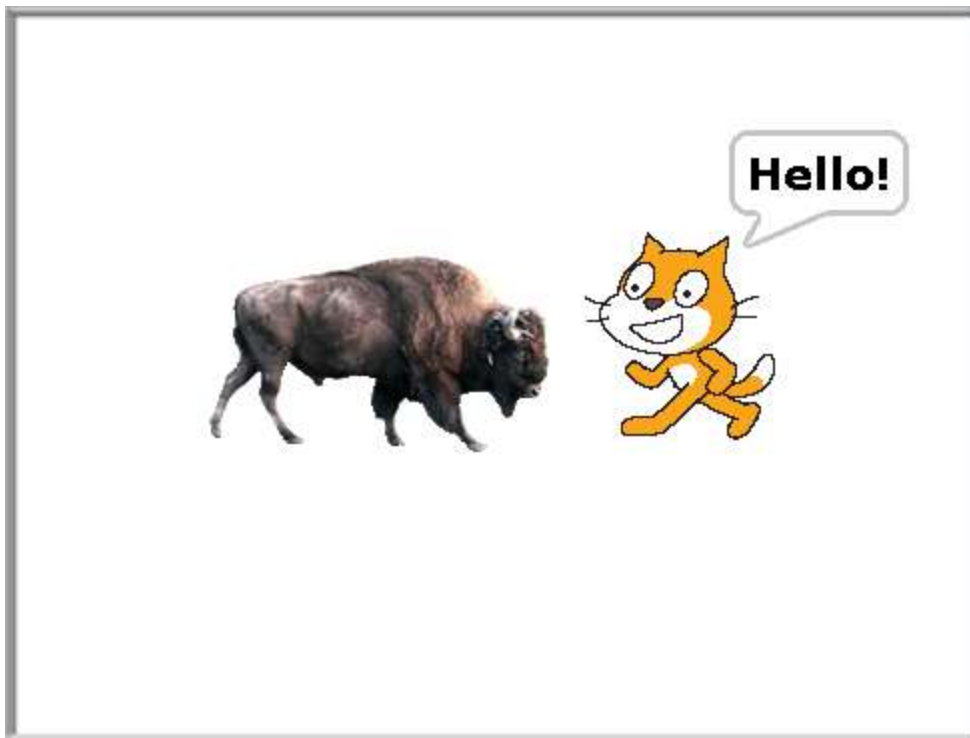
Let's press on the folder with a star and a window to choose a new object will open up.



Choose some character from the Animals folder. For example, a buffalo, and press OK.



Now the Cat is not bored!



Pay attention, at the bottom on the right, near the Cat, a buffalo showed up. But his name is not typical, it is «Sprite1» (the creators of the program, probably, like the Sprite drink very much).





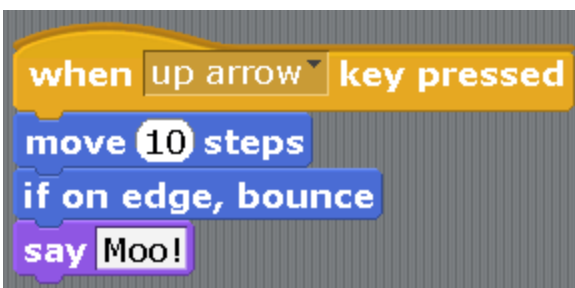
Highlight the buffalo (there will be a light blue frame around it, as in the picture above) and at the top of the screen give him a name «Buffalo» instead of «Sprite1».



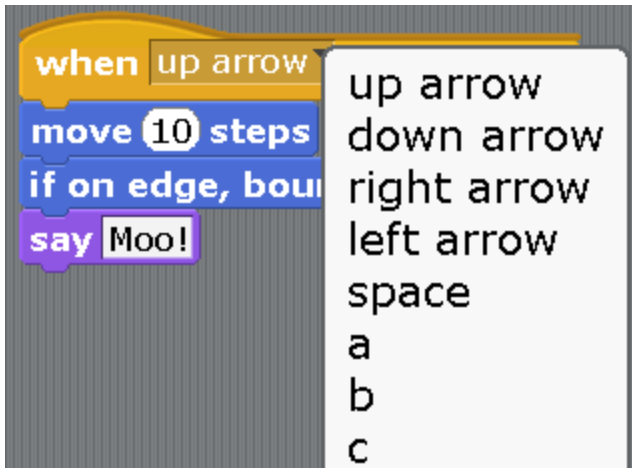
His name will also change at the bottom on the right.



Make this program for the Buffalo and experiment with it.



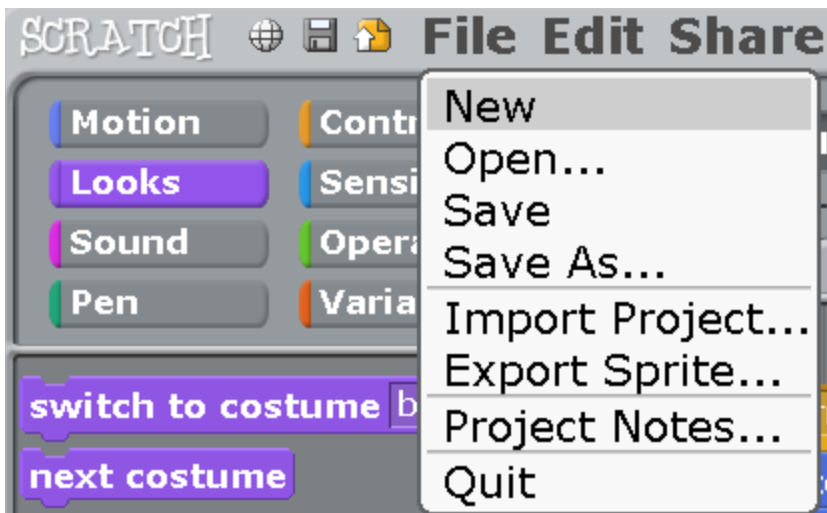
The yellow block «when up arrow key pressed» is made of the block «when space key pressed» by pressing on a small arrow.



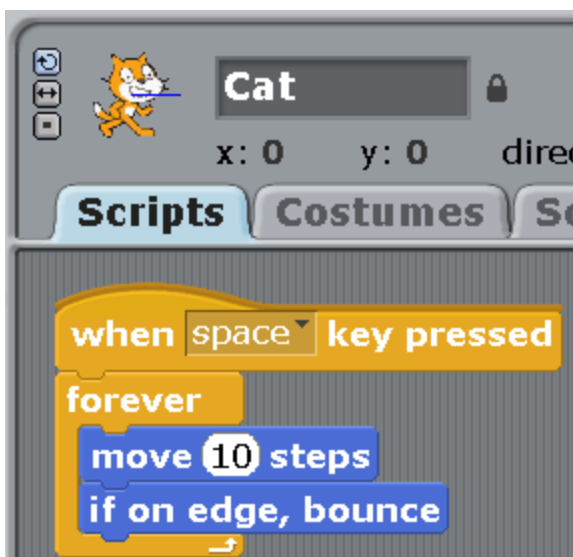
You could set up the Buffalo control on any arrow. Now you control the Cat by a space bar and the Buffalo by the up arrow.

### Chapter 3. Cyclical program flow.

Cyclical means repeating in a circle, when the same action is performed again and again. Create a new project. Press «File», then «new».



Everything will disappear, and the Cat is called Sprite1 again. Rename it into Cat. Now make the following program out of blocks.



Don't forget to press on the small button with the arrows for the Cat to always walk with the legs down.

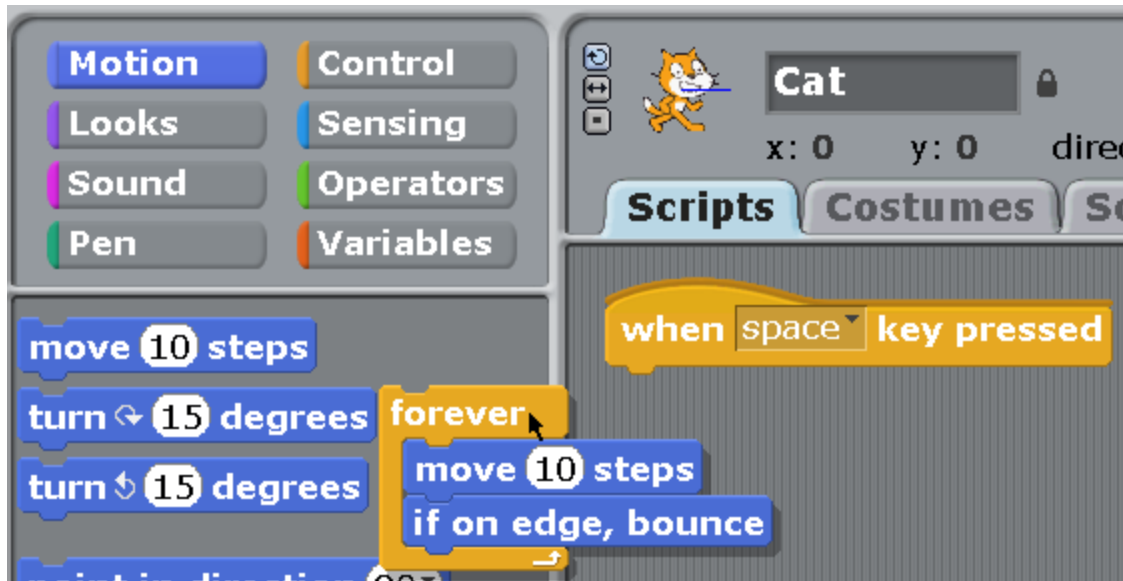


Press on the space bar, the Cat will be running non-stop. Since we have used the block «forever», the Cat will run until we stop him with the red button.

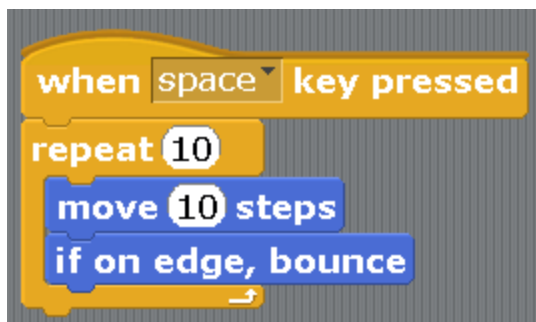


We will use the block «forever» very often.

Change the program. Delete the block «forever» with everything in it.

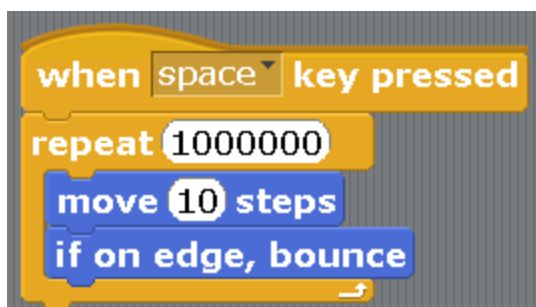


Click on it and drag it to the left to the blocks. Drop it there and it will disappear. Now make the following program. Instead of «forever» put «repeat 10» times.



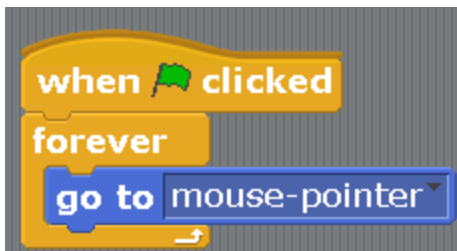
When pressing the space bar, the Cat makes 10 steps 10 times and stops. How many steps does the Cat walk?  $10 * 10 = 100$ . The star means the multiplication symbol.

If we write 1000 (one thousand) or 1000000 (one million) numbers in «repeat», the program will repeat for too long, almost like with the block «forever».



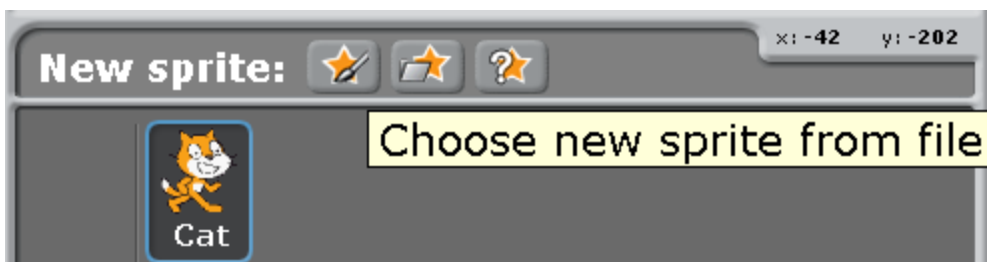
But it is wrong to write «repeat 1000000». It is correct to use the block «forever».

There is another very interesting block «go to...». Let us look at how it works. Make this small program. In the block «go to...» press on the little triangle and choose the mouse-pointer.

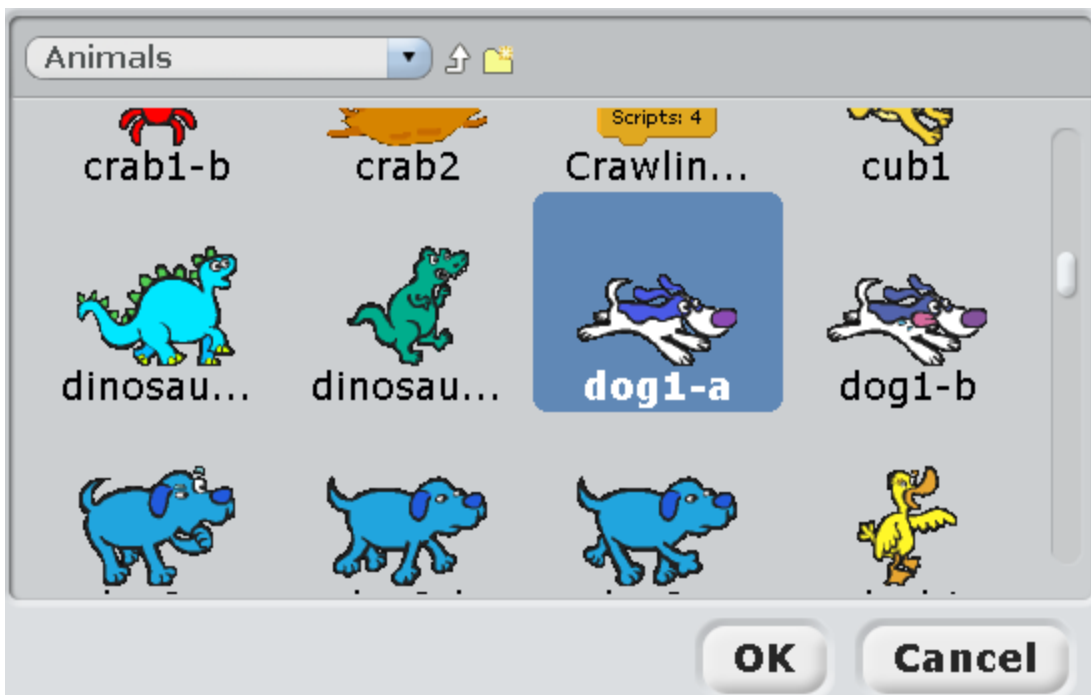


The green flag usually serves as a command to start running the program. Click on the flag. The Cat will attach to the mouse cursor. No matter how much you shake him, he won't fall off. In order for him to get off you need to click on the red circle. We will use this way of controlling the Cat in some games.

Add another character by clicking on the star with the folder.



Add some animal, for example, a Dog.



Give it a normal name — a Dog





You see that the Dog appeared right in front of the Cat.



Separate them. Put the Cat on the left and the Dog on the right.



It turned out pretty well, but to have a normal conversation, the Dog has to be facing the Cat. You can turn the Dog by clicking on the small Dog image at the top with a mouse, and dragging it to the side. The Dog will turn.



The Dog has turned upside down!



Oh well, this is not the way we talk either. In order for the Dog not to turn upside down, you need to click on the small button with two arrows.



That's another story!

«Hello, Catty Cat!»

«Hello, hello. Who poured blue paint on you?»

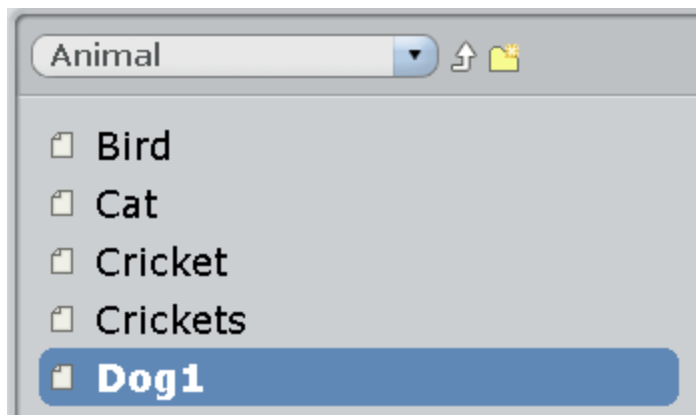


Now let's make a short cartoon about these characters. We will also learn about new blocks this way.

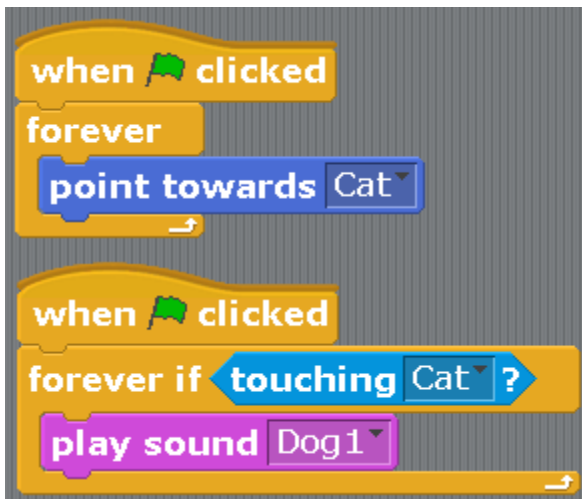
The Dog will bark. Add the sound «Dog1» for it. To do that, press the button «import» on the «sounds» tab.



Choose the sound you need in the «Animal» folder. OK. You have already done that, you should remember.



Then click on the «scripts» tab and make a program for the Dog.



This script uses new blocks. «Forever if» and a light blue block «touching the Cat». When the Dog touches the Cat, it will start barking. The first part of the program will turn the Dog facing the Cat.

Do the following for the Cat.

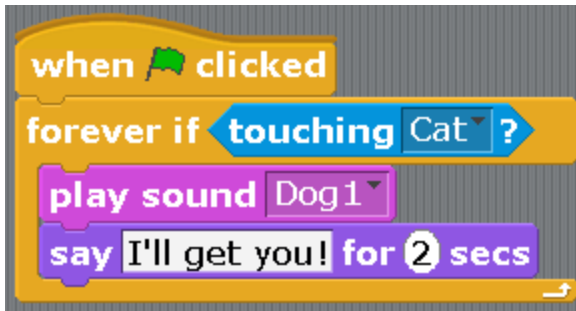


I think that everything is clear here.

Go ahead and click on the green flag, and try to carefully put the Cat closer to the Dog. As soon as the Cat touches the Dog, the barking and the meowing will sound just like in real life when you throw your cat on your neighbor's dog. If you don't touch the Dog but just let the Cat walk somewhere on the top of the screen, the Dog will turn to the Cat following him.

Let's add some cool stuff like giving them phrases, for example, these ones. Guess who gets what phrase.





In this game the Dog hasn't caught up to the Cat. When you learn to program better you can fix that.



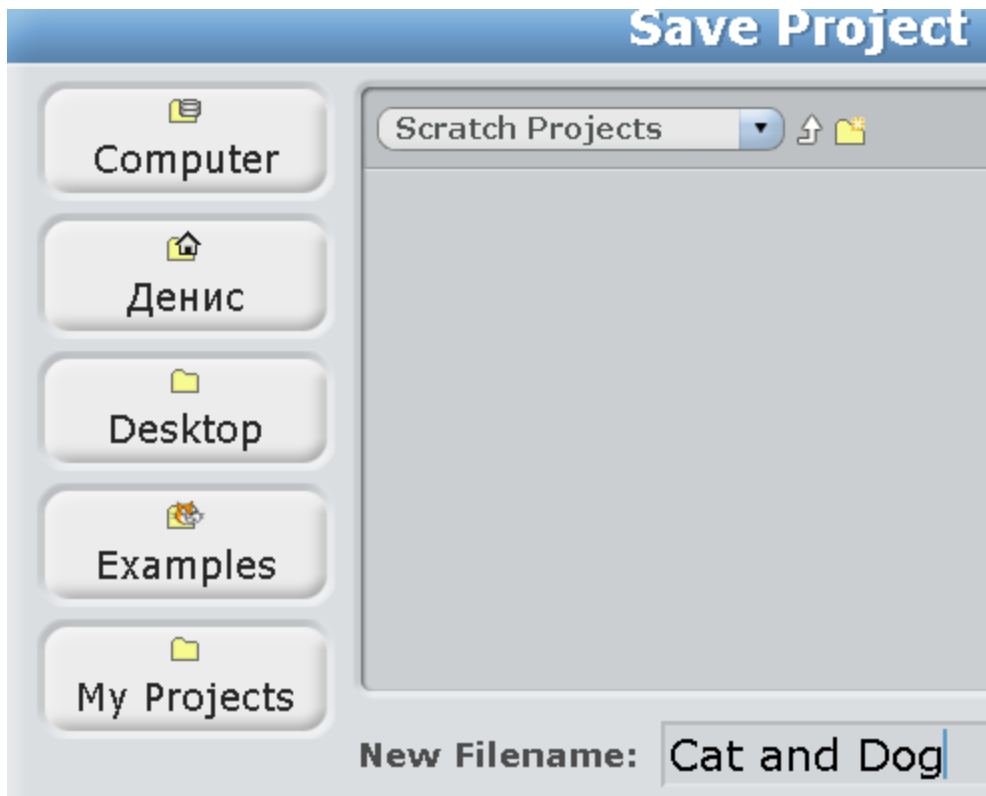
The program turned out to be interesting. Let's save it for memories. Then you can show it to your friends and parents. Click on the button that looks like letter H above the column.

«H» means NOT to forget to save. If we don't click this button, the whole program will disappear. We will have to do it again.



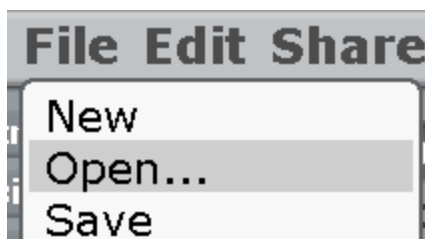
Adults call this button a «floppy disk». You can read more about the floppy disk in [Appendix 5](#). When you click on the button with the floppy disk, a window opens up where you need to write the name of the program at the bottom. Write down «A Cat and a Dog» and press Enter.



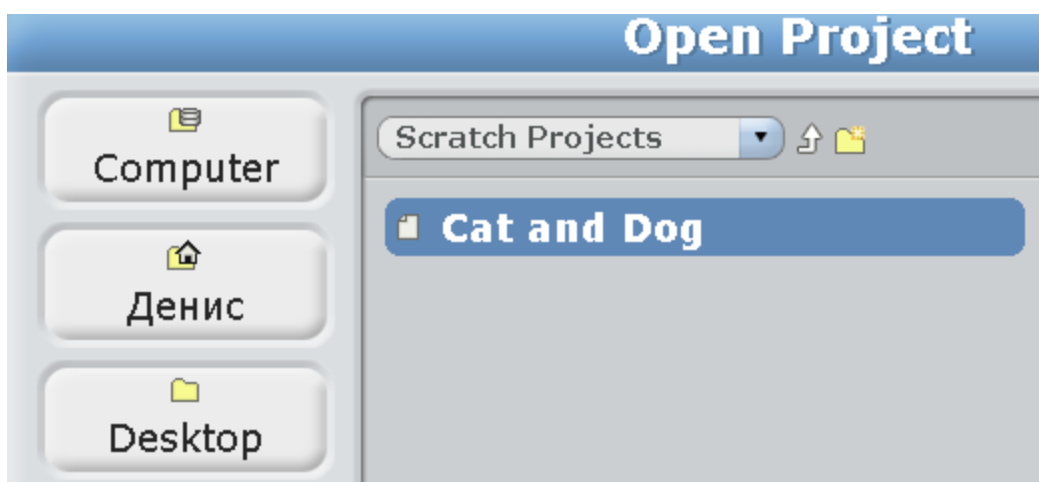


Now the program will not disappear anywhere.

In order to show the program to your friends, after you turn Scratch on, click on «File» and then «open».



Choose the program you need and then click OK

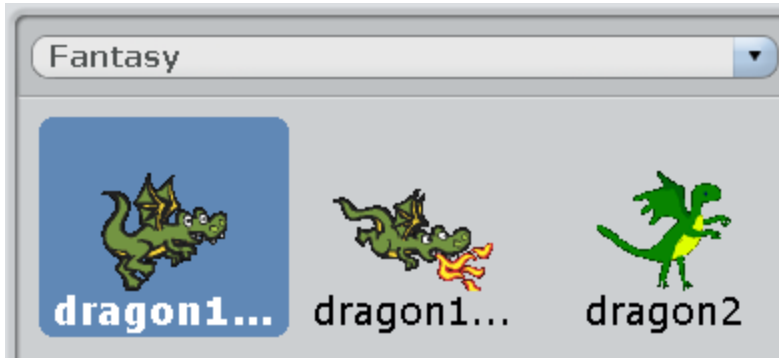


#### [Chapter 4. Another simple cartoon.](#)

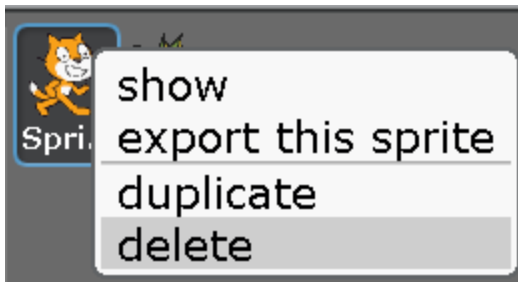
Open Scratch. Add two characters clicking on the folder with a star.



We are adding a simple dragon and a fire-breathing dragon. They are in the folder Fantasy.



Delete the Cat through the menu of the right button.



We rename the dragons into «Dragon1» and «Dragon2».

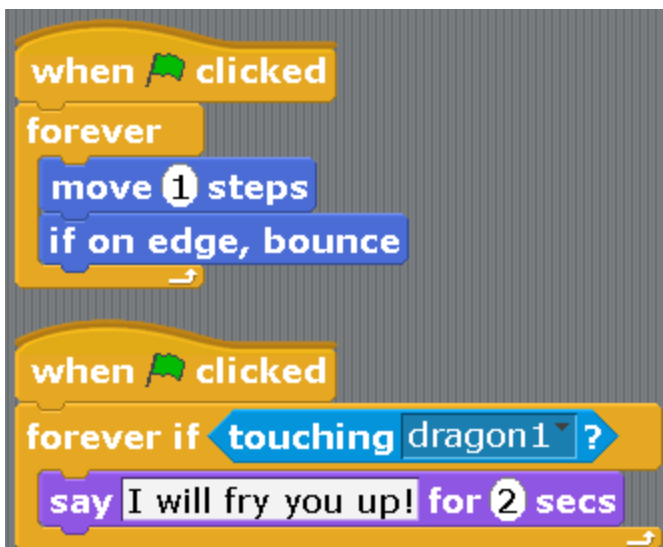


Then we put the simple dragon a bit higher up, and the fire dragon a bit lower down.



The simple dragon will stand in place for now, and the fire-breathing one will be flying and saying «I will fry you up!» when he touches the simple dragon.

Here is the program of the fire-breathing dragon.



Click on the green flag, the dragon is flying and turning at the edge with the legs up. We forgot about the small button with the arrows!

Press it.





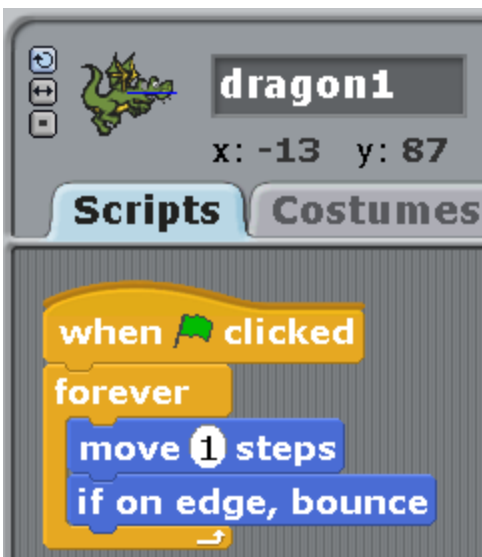
If the dragon is flying and not saying anything, then he is not touching the first dragon. Move him a bit up so that he does touch it.



You need to give the first dragon a chance to be saved. Let him fly, too.

Copy the script with the movement of the fire-breathing dragon for him. Click on it, drag it on the simple dragon, let go when a grey frame appears.

Then click on the simple dragon, he has got the same movement script.



What did you forget to click again?

????????????????????

The small button with two arrows!



Let's start the program. Great! Both are flying. But dragon1 is not reacting in any way when dragon2 is touching him. Let's copy the speaking script of dragon2 for him as well.

Go in dragon2 and drag the second script on the first dragon. When the grey frame appears, release it.



This script should be changed a bit. This is how it should be.



A short cartoon is ready.



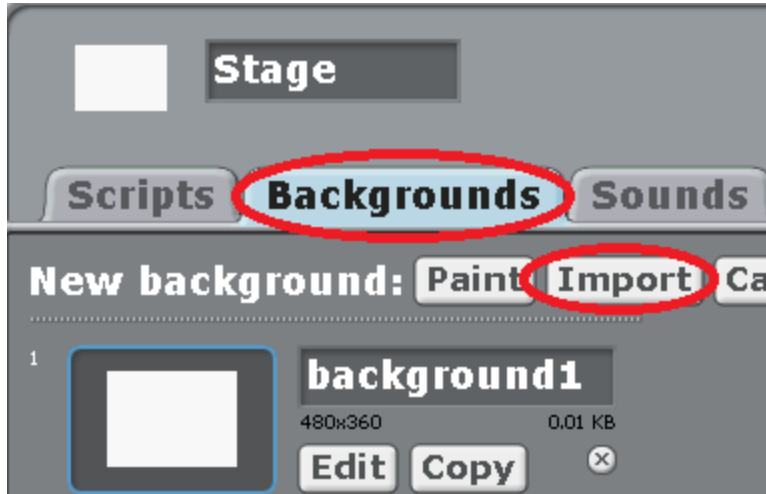
[Chapter 5. A cartoon with costumes. A flying cat and a bat.](#)

Create a new project. This will be a short cartoon about a Cat who walked along a desert, met a Bat and flew away from it on a jet-propelled backpack. The Bat will shed bitter tears.

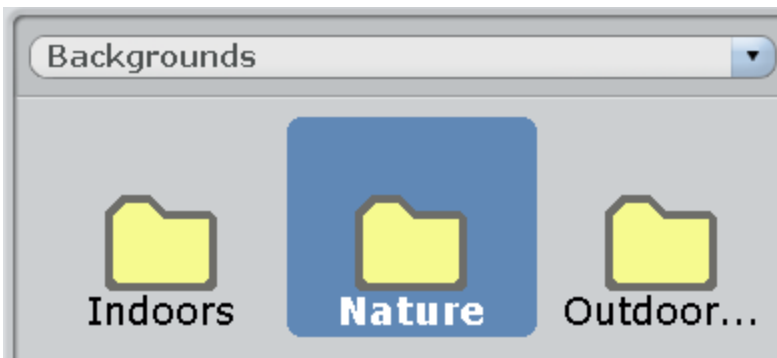


First, add the background.

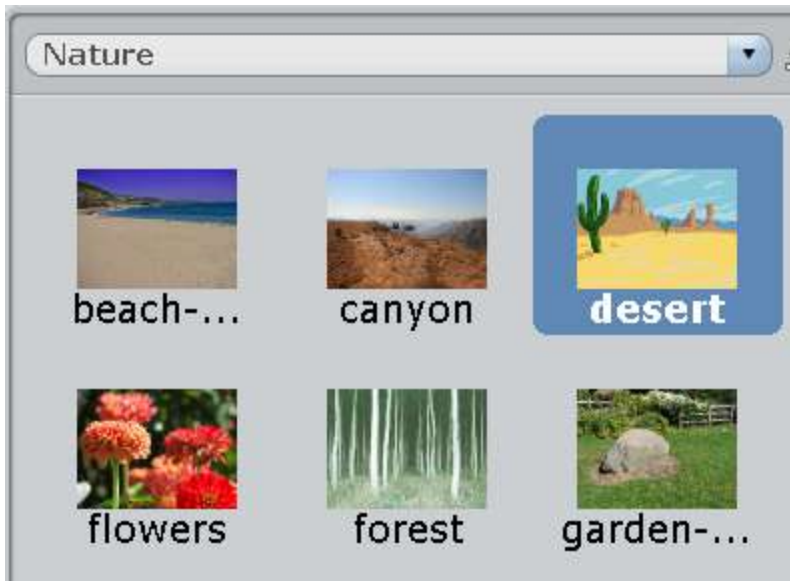
Click on the tab «backgrounds», then the button «import».



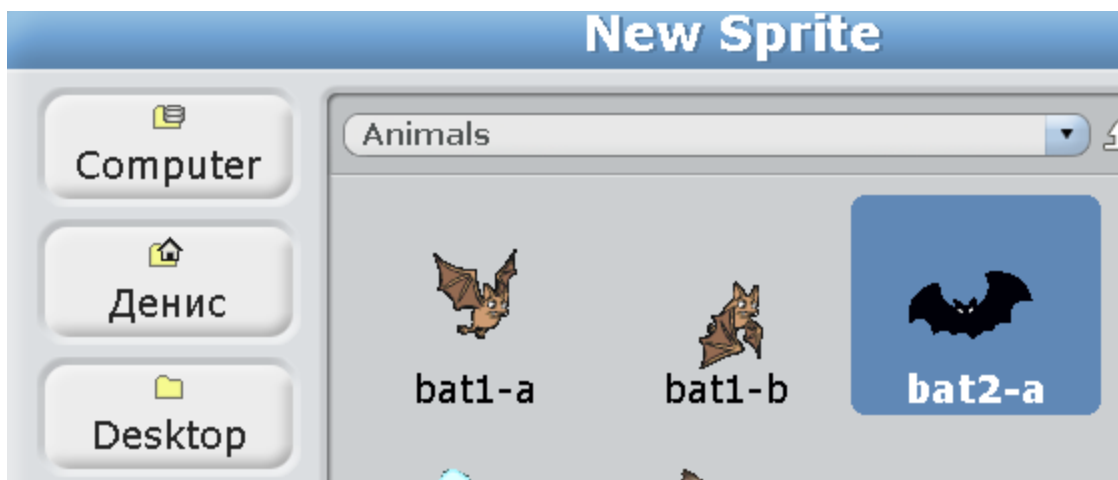
There are a lot of nature backgrounds in the folder Nature.



Choose the desert.



Add the character — the Bat.



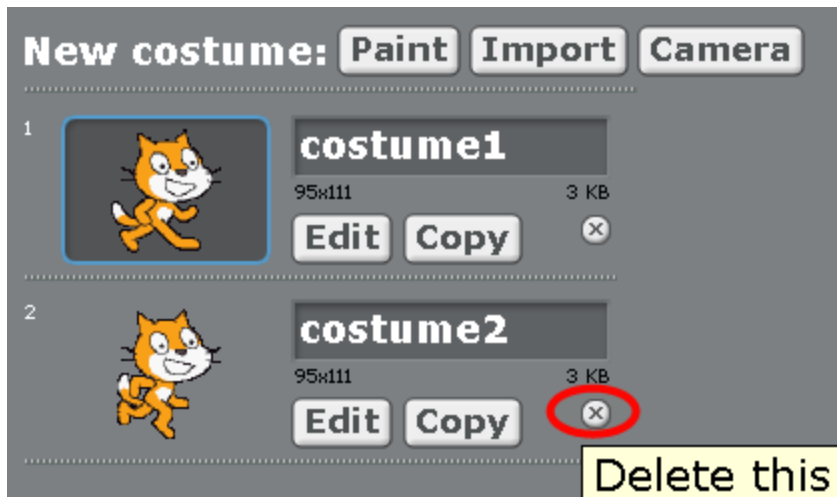
Rename the Cat and the Bat.



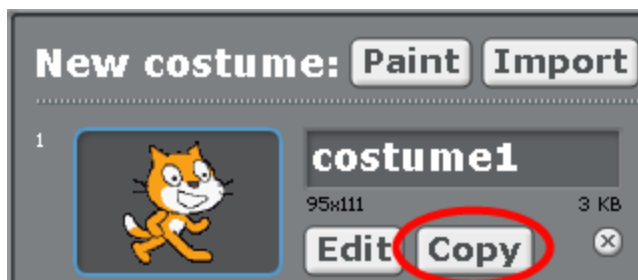
Now let's add several costumes for our characters.

First, for the Cat, Click on the Cat, then on the «costumes» tab.

The Cat already has Costume2, but we don't need it. Delete it with the circle with an X.



Now click on the button «Copy».



Costume2, a copy of Costume1, will appear.

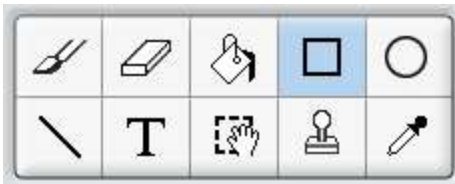


Let's add a jet-propelled backpack for the Cat on his Costume2. Click on the button «Edit» for Costume2. A drawing program will open up.

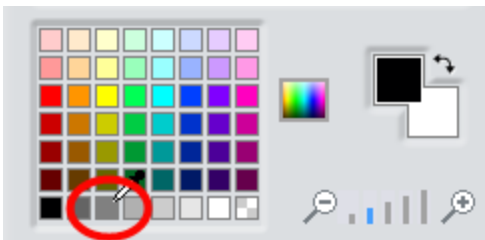




We need to draw an extra jet-propelled backpack. Click on the square.



Choose grey color with a dropper tool.



Draw a rectangle on the Cat's back.



Then pick the black color with the dropper tool and add a jet pipe.

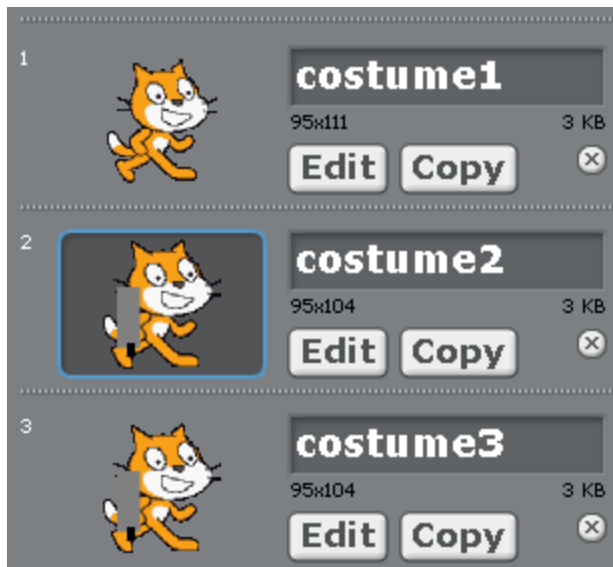


Click OK.

Now copy costume2.



Costume3 will appear, which will be an exact copy of costume2.



Click «edit» costume3.

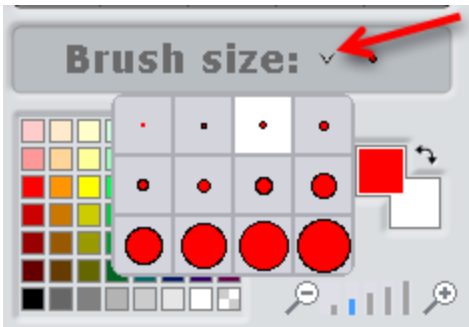
Choose a brush in the drawing program.



Pick the red color with the dropper tool.



Notice the small size chosen for the brush.



Draw fire.



Add more yellow in the middle of the fire.

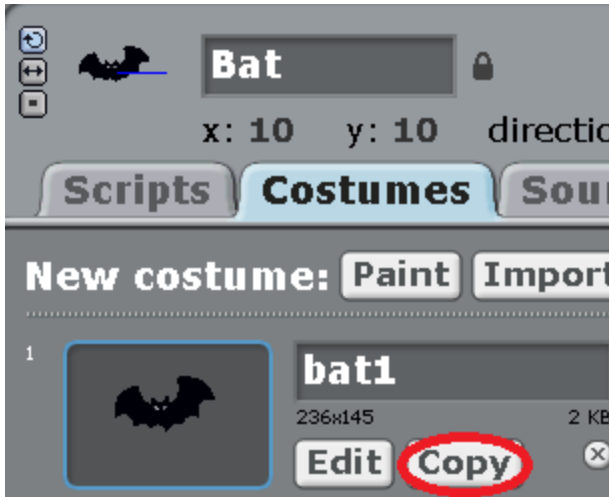


Now the fire looks real!

You should also add another costume for the Bat, but first you need to correct the costume name for it.



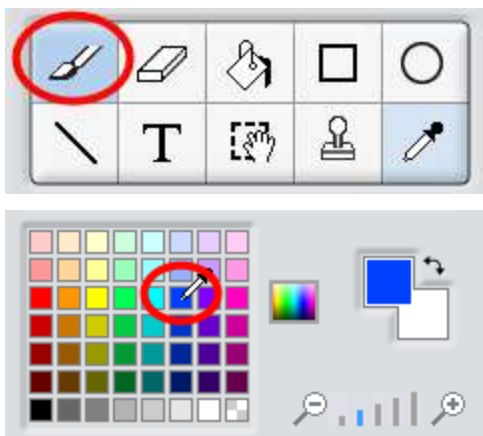
Write there bat1, then click «Copy».



Bat2 costume appears, and it has the right name right away!



Edit bat2. Add bitter tears to it with blue color.



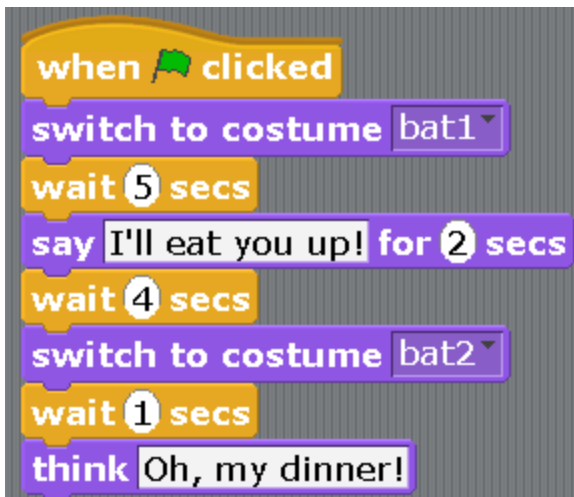
She cries and says, «My dinner!».



Now we have got the background, a Cat with three costumes, a Bat with two costumes. Make a program for the Cat.

```
when clicked
show
switch to costume costume1
go to x: -160 y: -72
wait 1 secs
glide 1 secs to x: -52 y: -87
say Hello! for 2 secs
wait 3 secs
say By by! for 1 secs
switch to costume costume2
wait 1 secs
switch to costume costume3
repeat 40
change y by 5
hide
```

Here we are using new violet blocks «show» and «hide», and two navy blue blocks «go to» and «swim 1 second to the point». It is probably clear how these blocks work. We will tell you later about the navy blue blocks. Make a program for the bat.



Start the program. If everything is done correctly, the Cat will come up to the Bat, tell her, «Hello!» The Bat will say, «I am going to eat you!» The Cat will put on the jet-propelled backpack, fly up and disappear. The Bat will cry, «My dinner!»

If something doesn't work, ensure the names on the costumes and the numbers on the blocks are correct. Some numbers have minus signs. These are negative numbers. We will tell you more about negative numbers in [Appendix 1](#).

### [Chapter 6. A game about the adventures of Theseus Kitten.](#)

Once upon a time there lived a kitten named Theseus in Chernobyl. He lived in a family of prospectors and smugglers of alien artifacts. One time the kitten Theseus went to crawl in a new basement in sector 13 to see what he could get. The walls of the basement were radioactive, so it was not permitted to touch them. All of a sudden, a desert rodent with the head of a Bull went in front of him!

Theseus was a very well-read kitten and right away understood who it was. Every night before bed he read a message on the poster that hung over his basket of respirators. There were no other words in his house, but he read this word more than a thousand times over and he was very proud of it. He was the most well-read in his family of smugglers. His father smuggler, read this word only ten times, and the mother smuggler read it only once, remembered it and didn't read it any more.

The poster showed a person with the head of a bull, and it says the word «Minotaur». In the basement, the kitten Theseus right away understood that this was exactly who it was in front of him! This was a mutant desert rodent with the head of a bull, very similar to the face of the Minotaur in the poster. Kitten Theseus took Kamae stance (moved his body to the right, loosened his shoulders naturally, bent his knees a bit, put his hands in fists and placed them at the chudan level). The Minotaur understood everything, this was not the first karate fighter in his life. With the scream, «Hey, Theseus! Don't hit me!» he disappeared, and nobody has ever seen him in the world ever again. Maybe they will find him somewhere on the Earth's orbit.

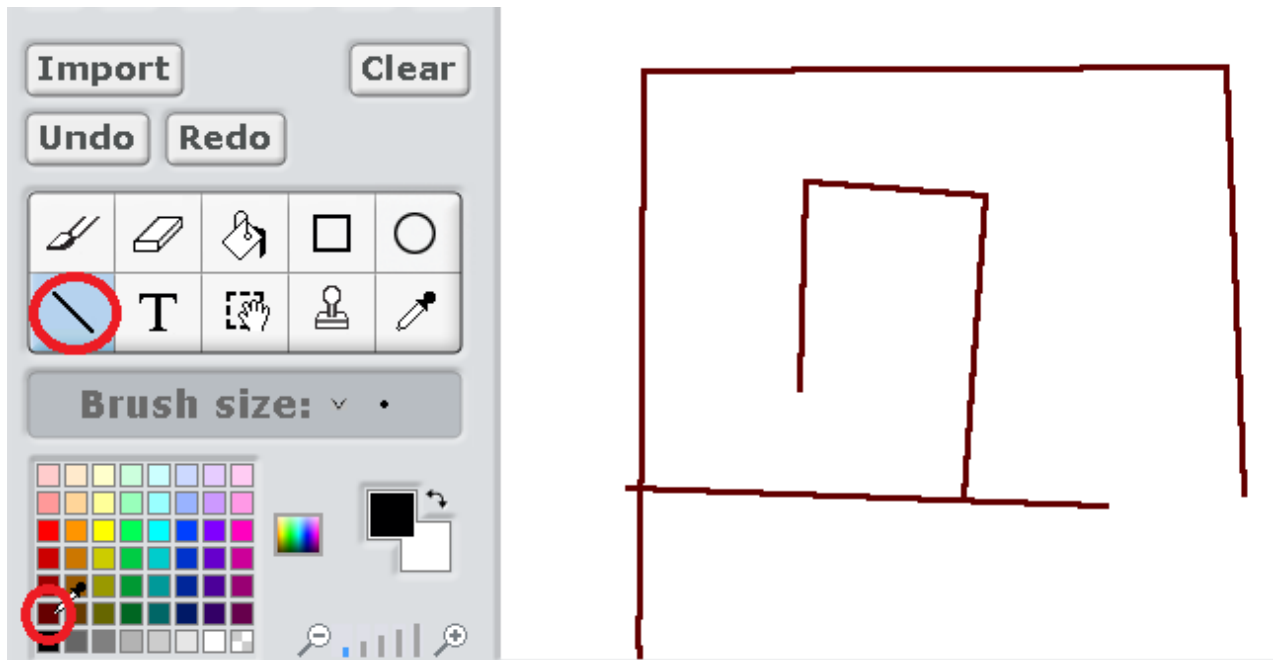
The game will look the following way. The Labyrinth with the Minotaur is in the center. A very small but brave kitten Theseus is in the corner.



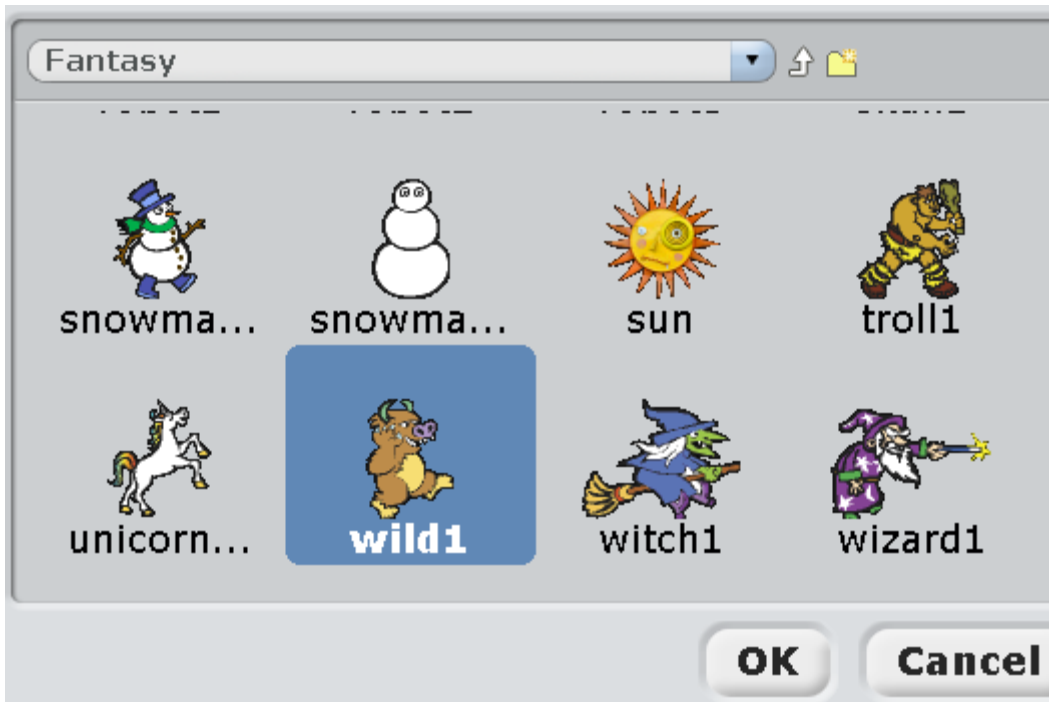
Create a new project.



As usual, we will first draw the background. It will be a labyrinth that the kitten will need to take. Choose the brown color.



We'll add the Minotaur. Click on the folder with the star and choose the Minotaur in the Fantasy folder, and click OK. Of course, it is not a completely correct Minotaur, and it doesn't look that much like a desert rodent, but this one will be fine for our game anyway.



Rename the kitten and the Minotaur.



Make the kitten smaller. Click the button for size reduction.



Then click on the Kitten a couple of times. It has to become of the size to be able to walk through the Labyrinth. Now make this program for the Kitten.



```

when space key pressed
show
say Hail to Poseidon! for 2 secs
forever
go to mouse-pointer
if touching color ?
say Ouch! for 2 secs
hide
stop all

```

And this program for the Minotaur.

```

when space key pressed
show
forever if touching Theseus ?
say Hey, Theseus! Don't hit me! for 2 secs
hide

```

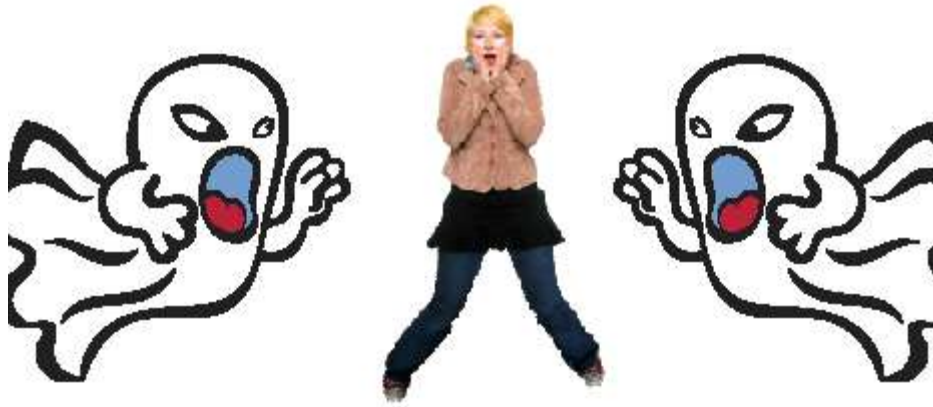
To start the program, click on the space bar. Don't forget to place the mouse cursor in the left bottom corner, not touching the brown color, or the game will end without even having started. Carefully move the Kitten along the Labyrinth towards the angry monster. Do not touch the radioactive walls. If the Kitten touches the brown color, he will say, «Oh!» and disappear. If you are able to go through the whole Labyrinth and touch the Minotaur, he will disappear screaming, «Hey, Theseus! Don't hit me!».

### [Chapter 7. A cartoon with ghosts.](#)

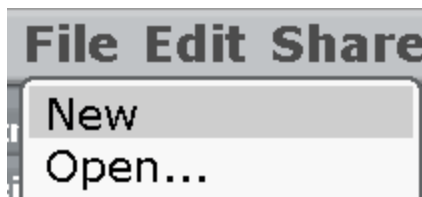
Once upon a time there lived a Girl. Once she walked around and all of a sudden, out of nowhere, two Ghosts fly to her and scare her.



«Help me, save me!»



As usual, first, create a new program. Click on File, «New».



Let us add characters through the folder with a star. First, let us add the Girl and one Ghost. Then we will make the second Ghost by repeating.

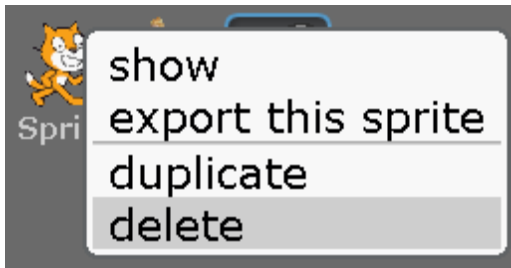
The Girl is in the folder People.



The Ghosts are in the folder Fantasy.



Now we need to delete the Cat. Click on it with the right button and choose «delete».



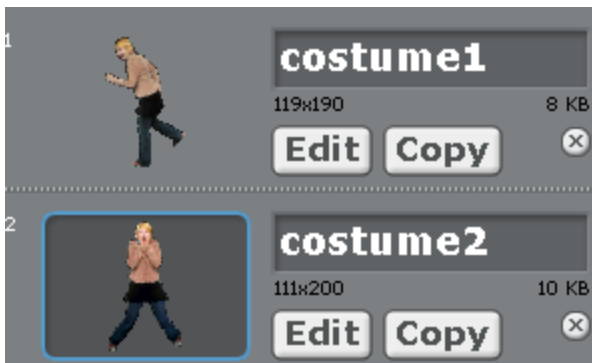
Rename the Girl and the Ghost.



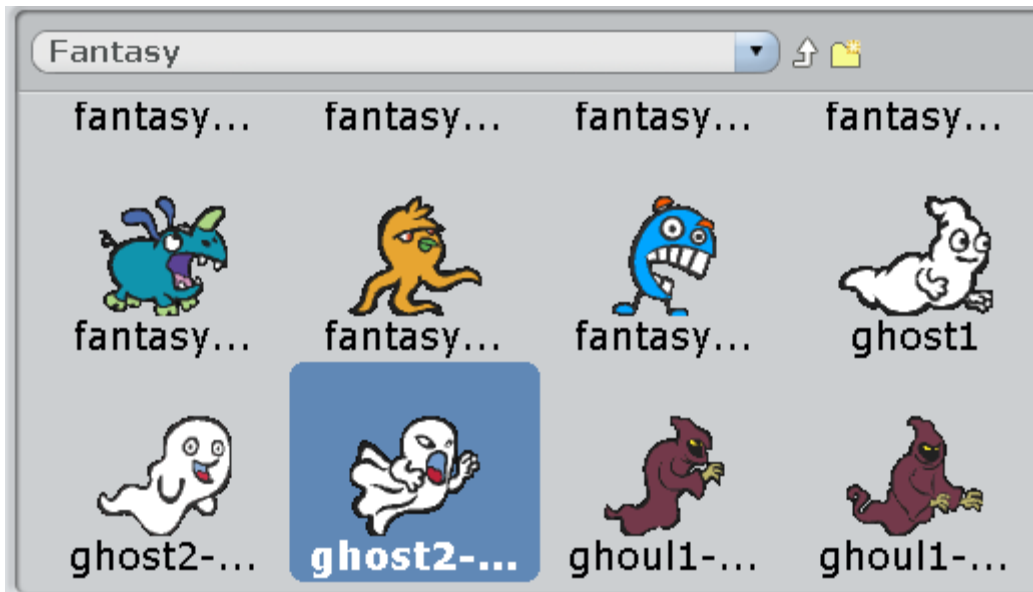
Add a scared costume for the Girl. Click on the tab «Costumes» and the «import» button. Choose a scared Girl in the People folder.



Rename the costumes.



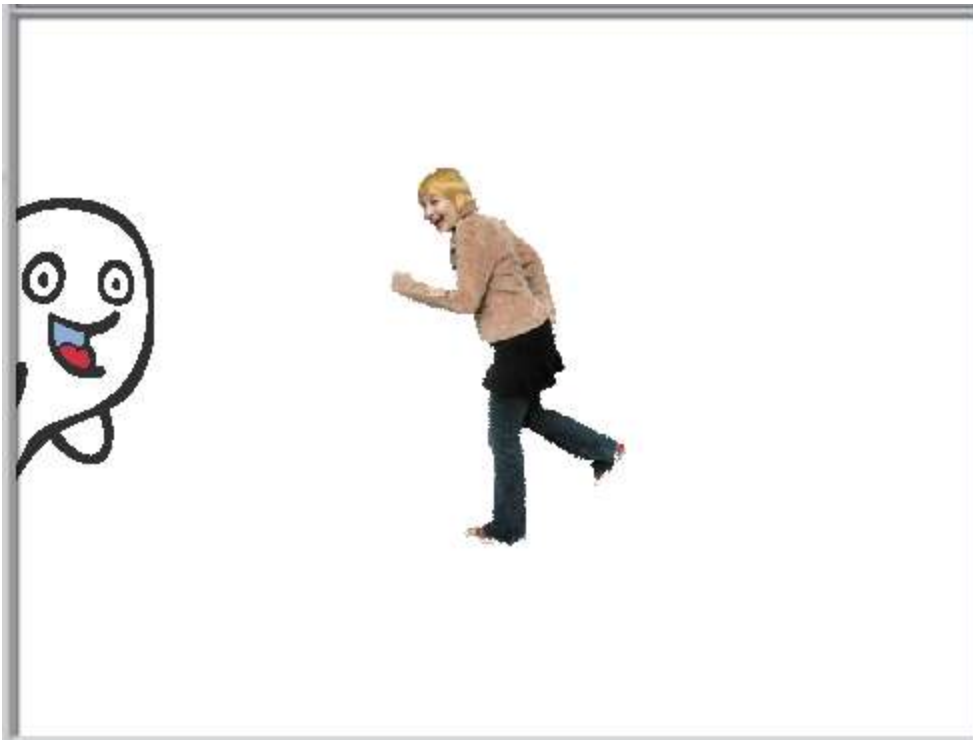
Add a costume for the Ghost.



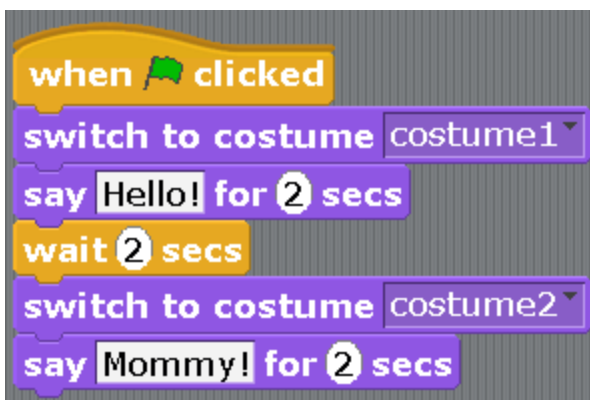
Rename the costumes.



Place the Girl in the center of the screen, and the Ghost to the left behind the side.



Make this program for the Girl.



And this one for the Ghost.

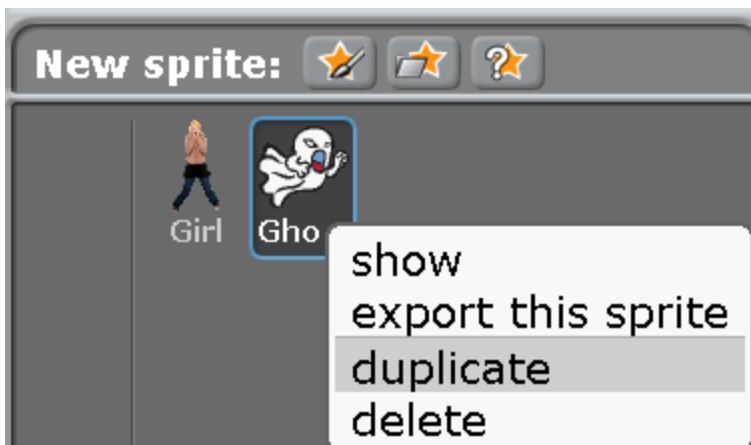
```

when green flag clicked
  go to x: -255 y: 0
  switch to costume ghost1
  set ghost effect to 100
  wait 2 secs
  repeat 50
    change x by 2
    change ghost effect by -2
  switch to costume ghost2
  say Ha-ha-ha for 2 secs

```

Check how everything is working. At first, you cannot see the Ghost. The Girl is walking in the middle of the screen and says, «Hello!» Then a Ghost smoothly appears and comes closer to the Girl. The Ghost yells, «Ha-ha-ha!» and scares the Girl. She screams, «Mommy!» If the program doesn't work correctly, carefully check all the numbers. Make sure that we first move on to costume1, then to costume2.

Now we need to make the second Ghost. This is very simple. Click on the Ghost with the right button and choose «duplicate».



The second Ghost with the name Sprite1 appears.



Rename him into Ghost2

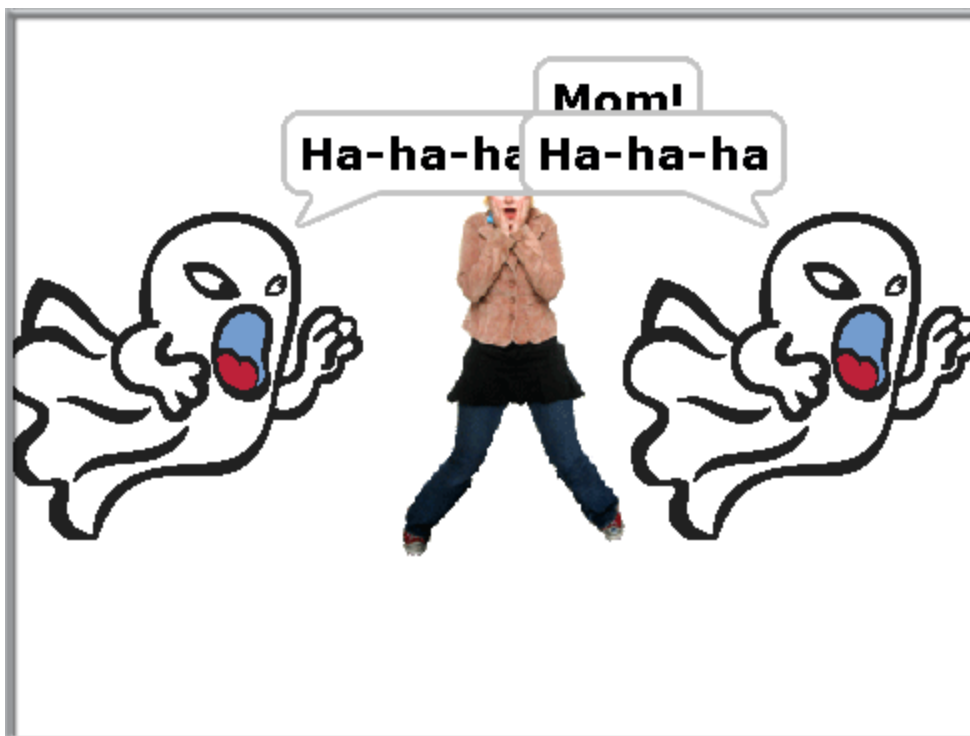


Notice that the second Ghost already has a program! It is the same as the program of the first Ghost. You need to change it. Do the following.

```
when clicked
  go to x: 255 y: 0
  switch to costume ghost1
  set ghost effect to 100
  wait 2 secs
  repeat 50
    change x by -2
    change ghost effect by -2
  switch to costume ghost2
  say Ha-ha-ha for 2 secs
```

Only two changes: change -255 to 255 in the block «go to», you take out the minus, and change 2 into -2 in the block «change x for», so you add the minus.

Start the program.



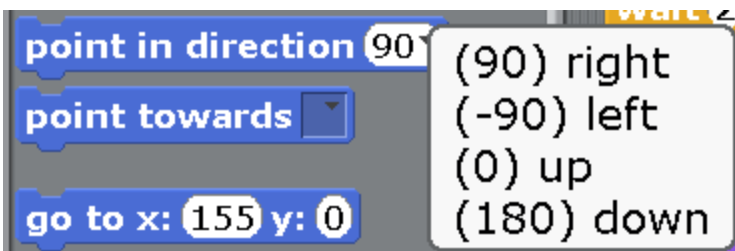
It seems that the second Ghost is looking the wrong way. Of course! We have copied it from the first one! We need to turn it the other way. Click on the little button with two arrows, then click on the Ghost and drag the mouse to the left, it will turn to the left.



Notice the message «direction -90».

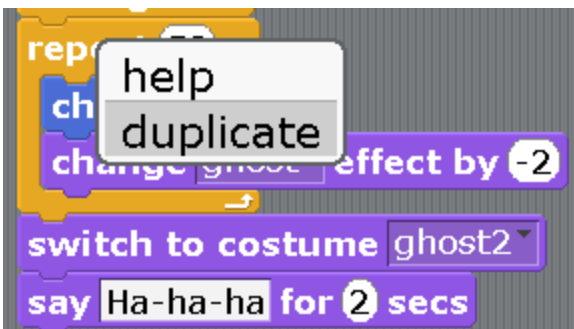


If the character is facing right, that is direction 90. If he is facing left, then direction -90. For a hint you can click on the triangle of the block «turn in the direction» and a hint will drop down.

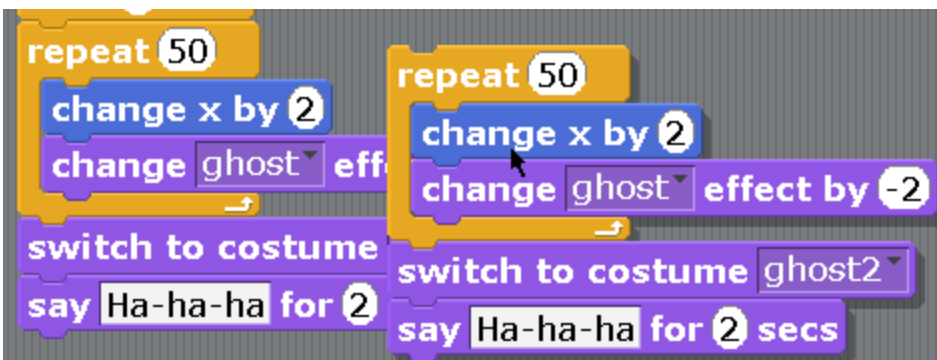


We tell about directions and degrees in detail in [Appendix 3](#), and about x and y coordinates in [Appendix 2](#).

Start the program. The Ghosts will come over, scare the Girl and stay in place. Let's make it that they fly away and become invisible. That is very simple. Let us repeat a part of the program for Ghost1. Right-click on the block «repeat 50» and choose «duplicate».

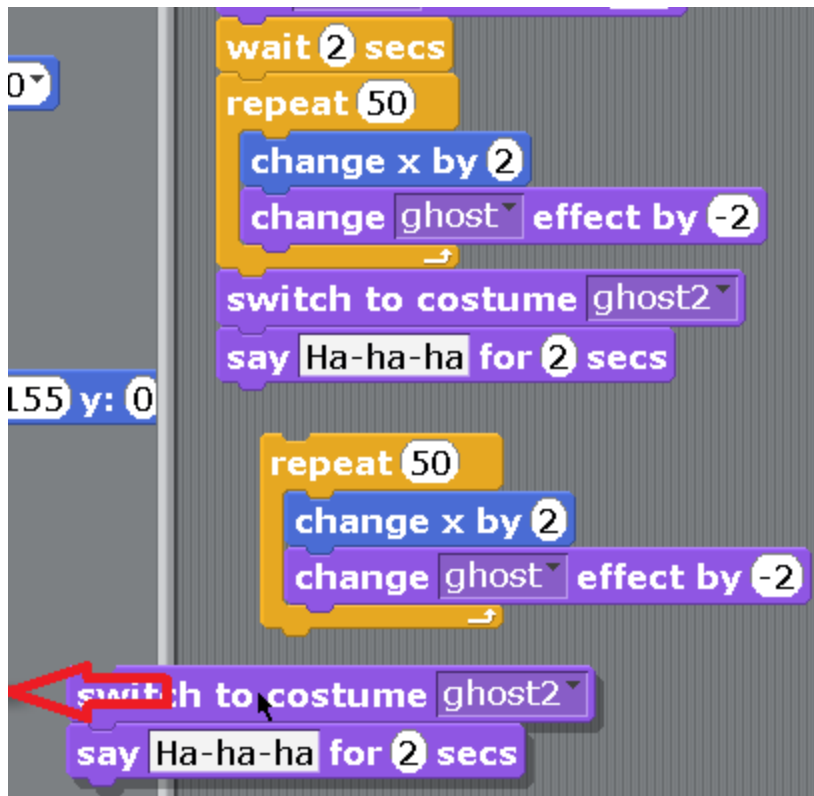


You will get a copy of these blocks.

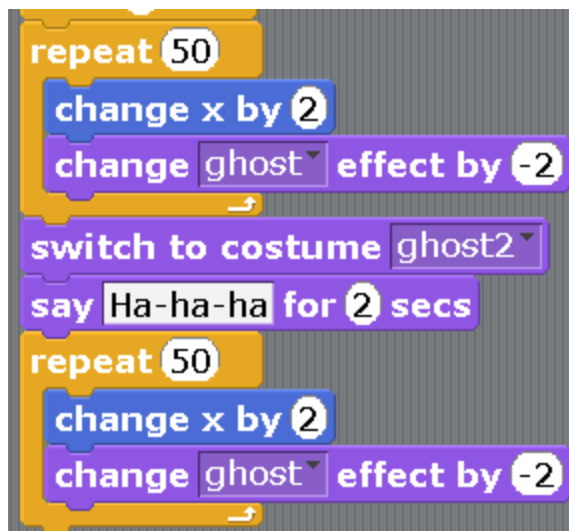


Put them next to the program, delete the bottom two blocks dragging them to the left.





Attack the module «repeat 50» to the bottom of the program.



Now let's change the number on the block «change x to 2» to -2. We change the number to 2 in the block «change the effect ghost by -2». This is what we'll get.

```
repeat 50
  change x by 2
  change ghost effect by -2
switch to costume ghost2
say Ha-ha-ha for 2 secs
repeat 50
  change x by -2
  change ghost effect by 2
```

We'll do the same with the second Ghost.

This is the program for the second Ghost that we'll get.

```
repeat 50
  change x by -2
  change ghost effect by -2
switch to costume ghost2
say Ha-ha-ha for 2 secs
repeat 50
  change x by 2
  change ghost effect by 2
```

Let's start the program. If something is not working the right way, look carefully at the numbers and the costumes. First at costume1, then at costume2.

### [Chapter 8. A game with mines.](#)

Once the Cat went to explore, and there appeared a mine field in front of him. The Cat uses the keyboard to control movements and walks on the field. If the Cat steps on a Mine, he will blow up and disappear.



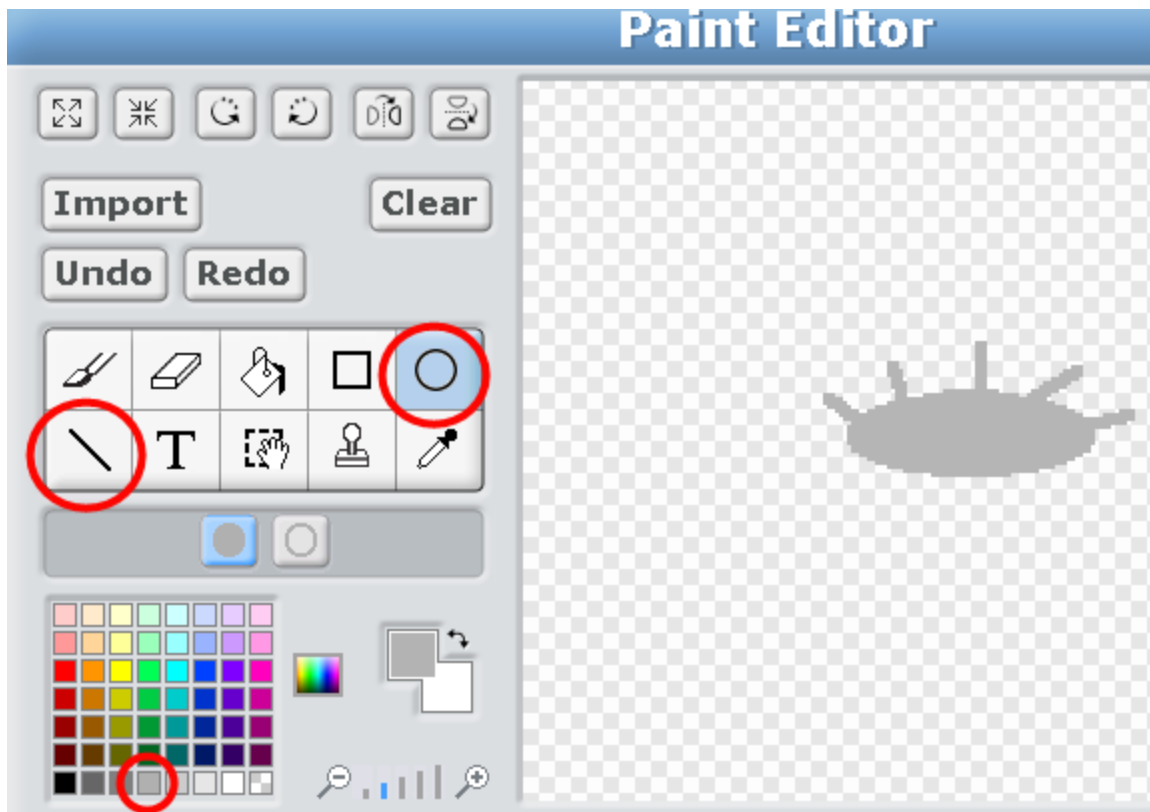
The game goes on with a timer — who is going to get to the finish line faster. We are going to use three steps to make the game.

The first step.

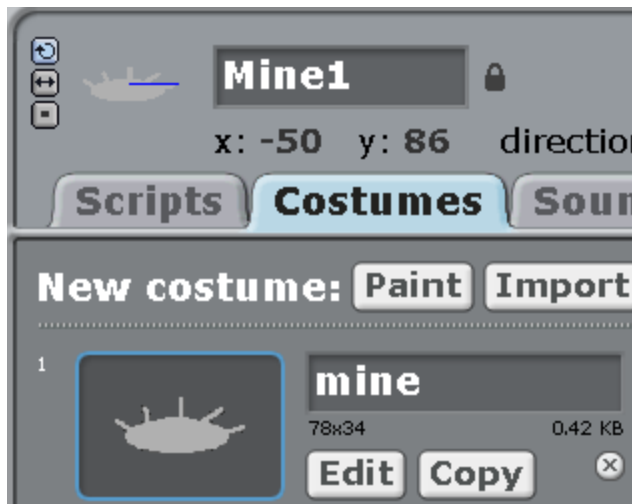
As always, first, we rename the Cat and draw sprites. We cannot call the Mines and the Finish characters. Let's call all the non-living objects sprites. Let's click on the brush with a star.



We draw a Mine in the drawing program. First, we draw an oval, then we add sticks to it. Don't forget to choose the grey color with your dropper.



Let's call a mine Mine1, and the costume — Mine.



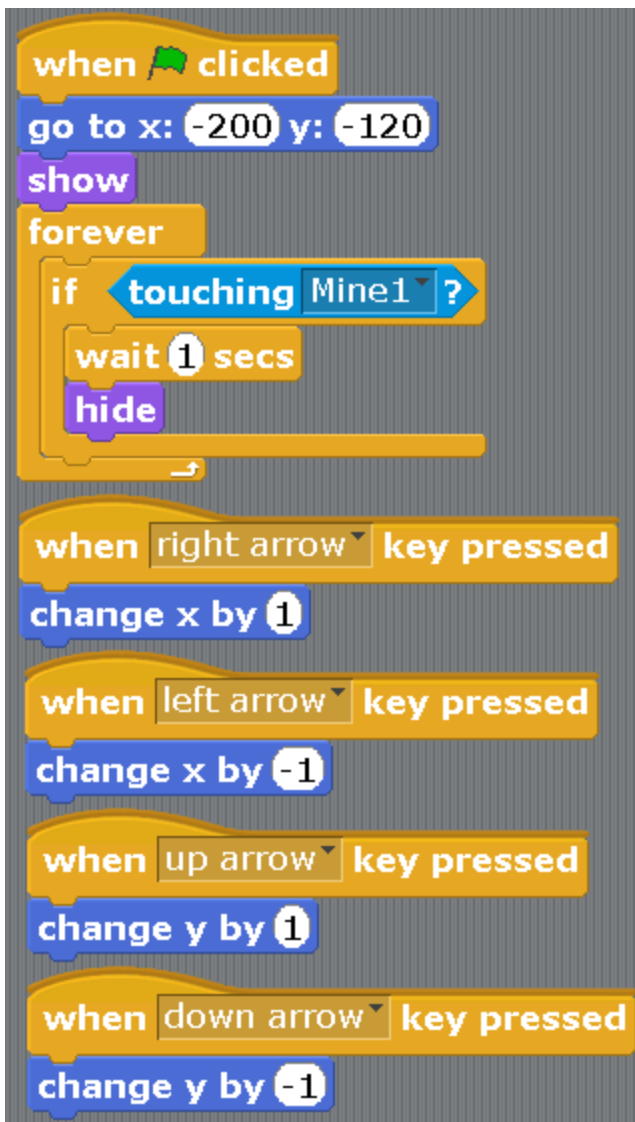
Now we need to draw a second costume for Mine1. Click on «Paint».



Draw an explosion.



Make the following program for the Cat.



Everything is simple and understandable here. If the arrow is clicked to the right, then we switch x to 1, that is, the Cat is moving to the right.

We switch x to -1 for the arrow to the left, and the Cat is moving to the left.

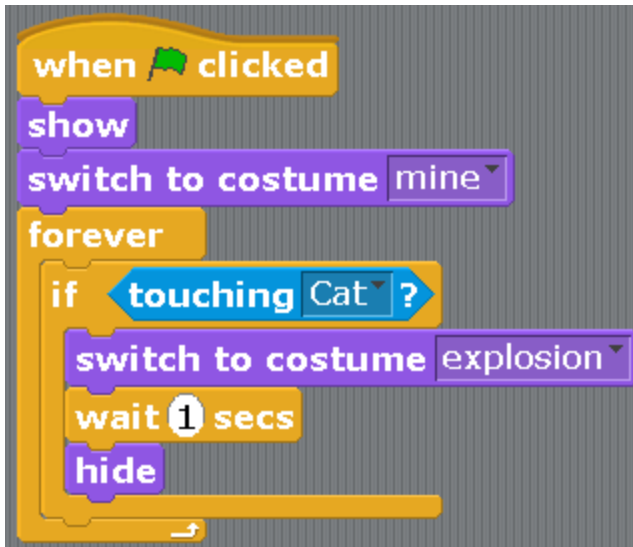
We switch y to 1 for the arrow up, and the Cat is moving up.

We switch y to -1 for the arrow down, and the Cat is moving down.

If the Cat touches the Mine, he will hide as if he blew up.

You can read more about x and y in [Appendix 2](#).

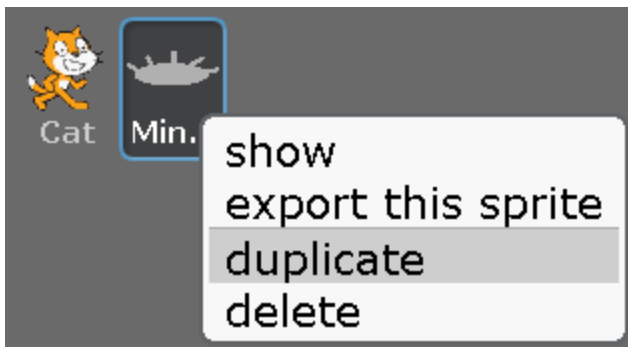
Let's make a program for the Mine.



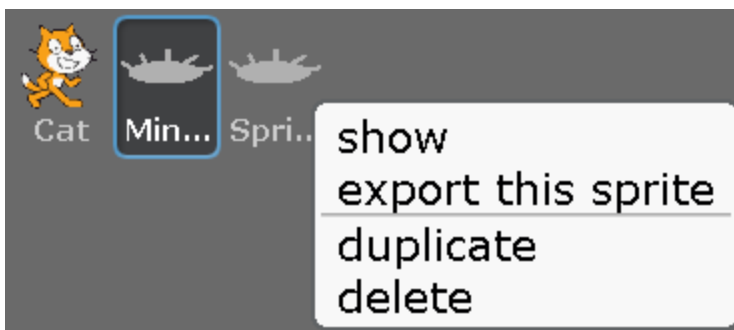
Click on the green flag controlling the arrows, move the Cat to the Mine. There should be an explosion.

The second stage. We make three mines.

Right-click on the Mine and copy it.



Copy it again.



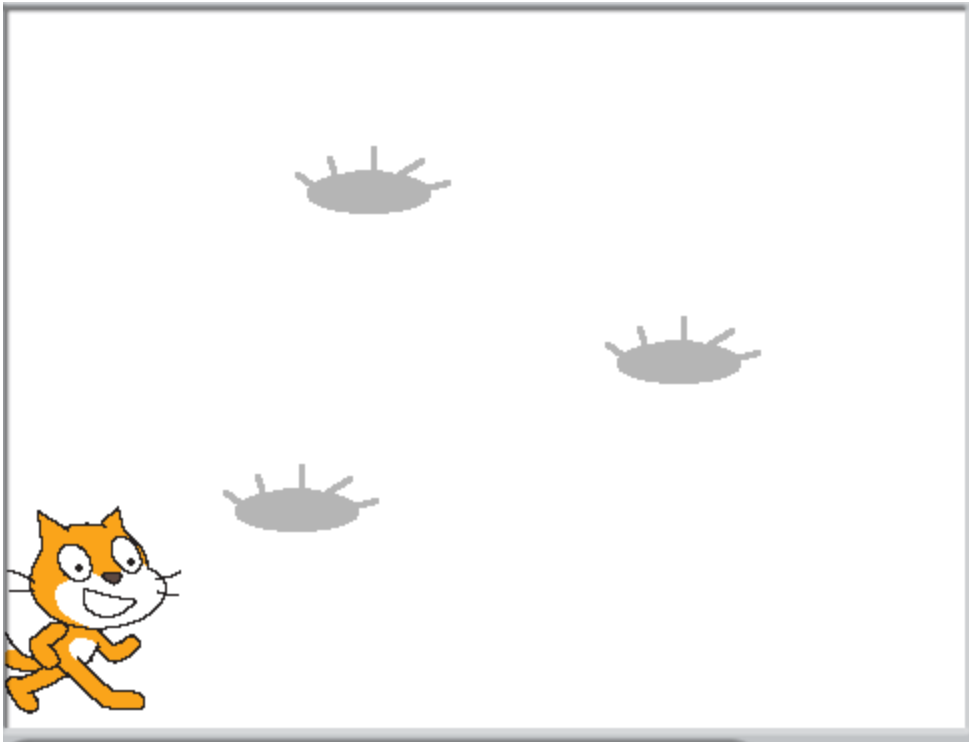
You have got three mines. Rename them into Mine2.



And Mine3.



Drag the Mines along the playing field. You need to place them in such a way that the Cat would be able to pass between them.

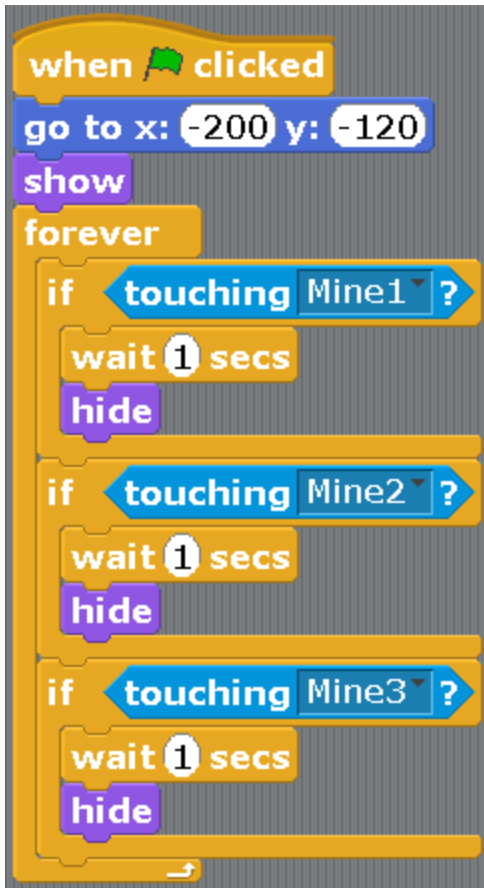


If the Cat can barely pass through the Mines, you can make him smaller. Click on the button on top.



Then click on the Cat and he will become smaller.

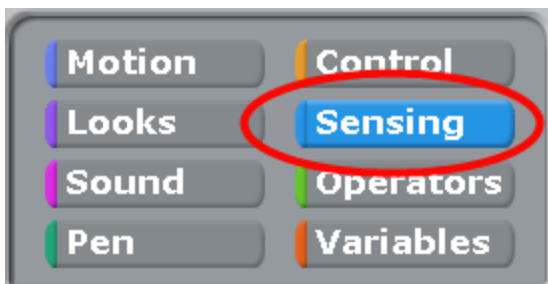
Since we have three mines now, the Cat's program needs to be changed.



Click on the green flag. Walk along the Mine field with the Cat.

The third step.

Now is the time to improve the game a little bit more in order to have more fun playing. Let's add a Timer. That's a special timer that shows the amount of time that took you to go through the game. Choose light blue blocks «Sensing».



Check the «timer» block.



Add the command «Reset timer» into the program for the Cat. The Cat's program will be the following.

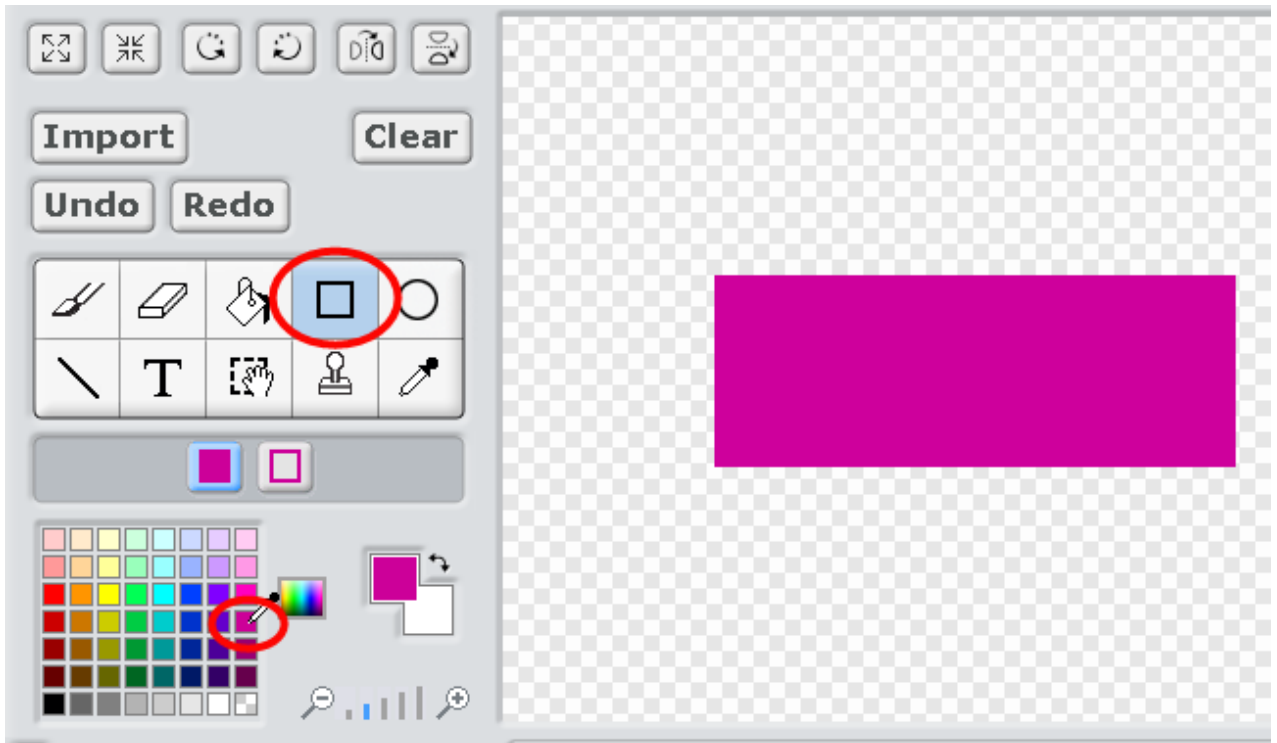


```
when clicked
  reset timer
  go to x: -200 y: -120
  show
  forever
    if touching Mine1 ?
      wait 1 secs
      hide
    if touching Mine2 ?
      wait 1 secs
      hide
    if touching Mine3 ?
      wait 1 secs
      hide
```

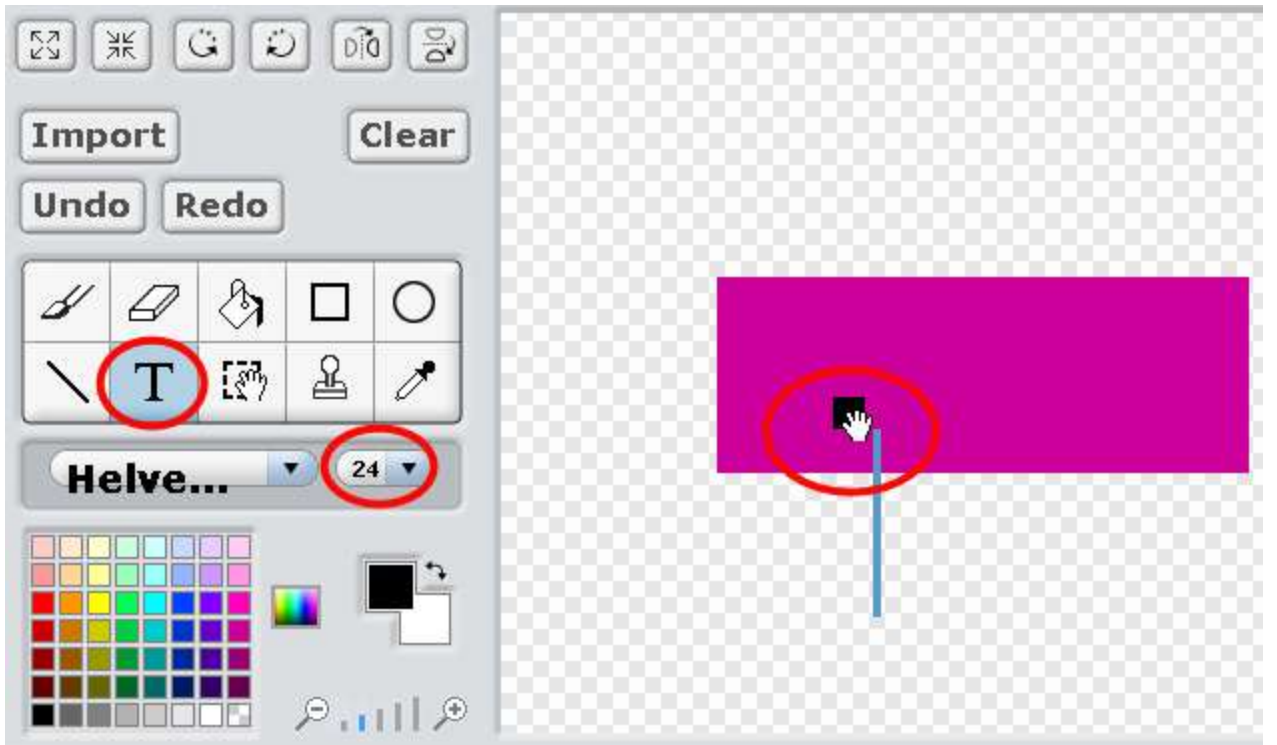
We'll add a new sprite — Finish. Click on the star with a brush.



Draw a rectangle.



Write the word «FINISH» in the center. To do that, click on letter «T» and drag the text to the center of the rectangle. When you put the mouse in the black square, the cursor will look like a hand.



If the text is not exactly in the middle, drag it



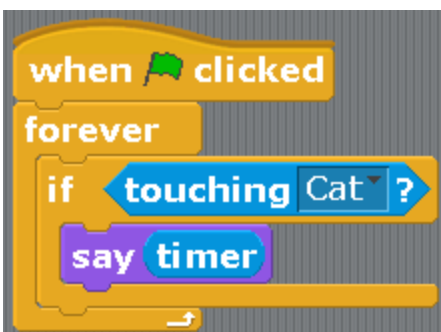
Rename the new sprite.



Place Finish on the right at the bottom.



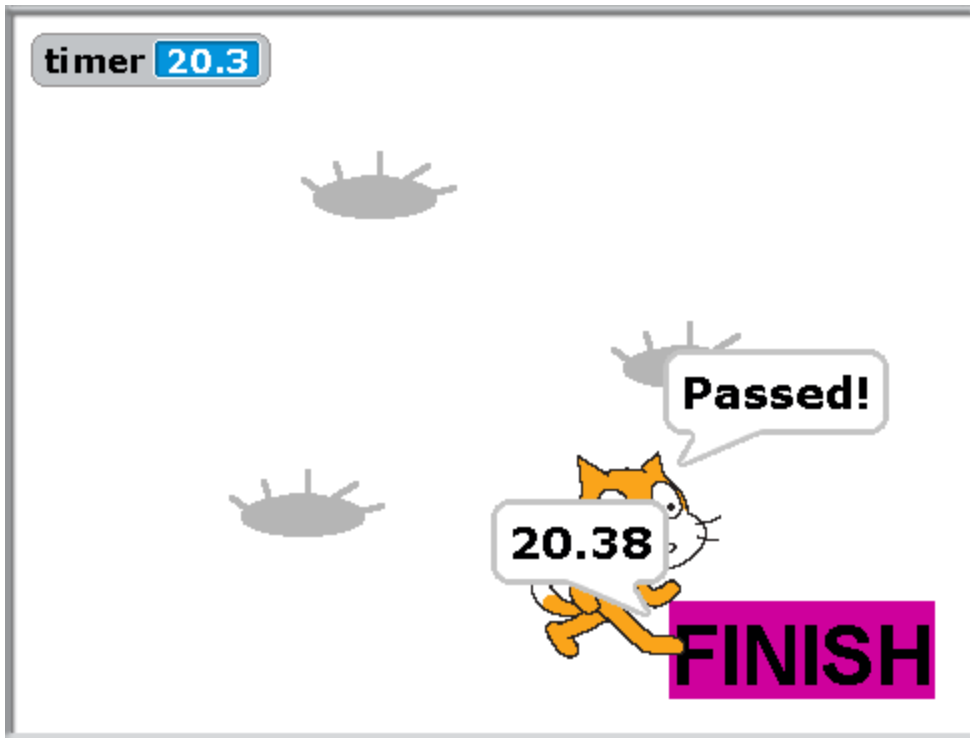
Write the following program for Finish.



Change the Cat's program. Add «if touching finish».

```
when green flag clicked
  reset timer
  go to x: -200 y: -120
  show
  forever
    if touching Mine1 ?
      wait 1 secs
      hide
    if touching Mine2 ?
      wait 1 secs
      hide
    if touching Mine3 ?
      wait 1 secs
      hide
    if touching Finish ?
      say Passed! for 2 secs
```

Click on the green flag, try to go through the game. In order to stop the times value your Cat needs to touch the Finish and step back a bit right away.



A question. How can we make the Cat move faster?

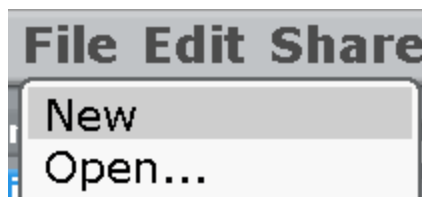
A task. Add another mine.

### [Chapter 9. A short cartoon about an evil butterfly.](#)

Let's make a cartoon about a flower where a butterfly is sleeping. If we click on the flower with the mouse, the butterfly will wake up and ask, «Did you wake me up?» The next thing the butterfly does depends on the answer.



Let's create a new project.

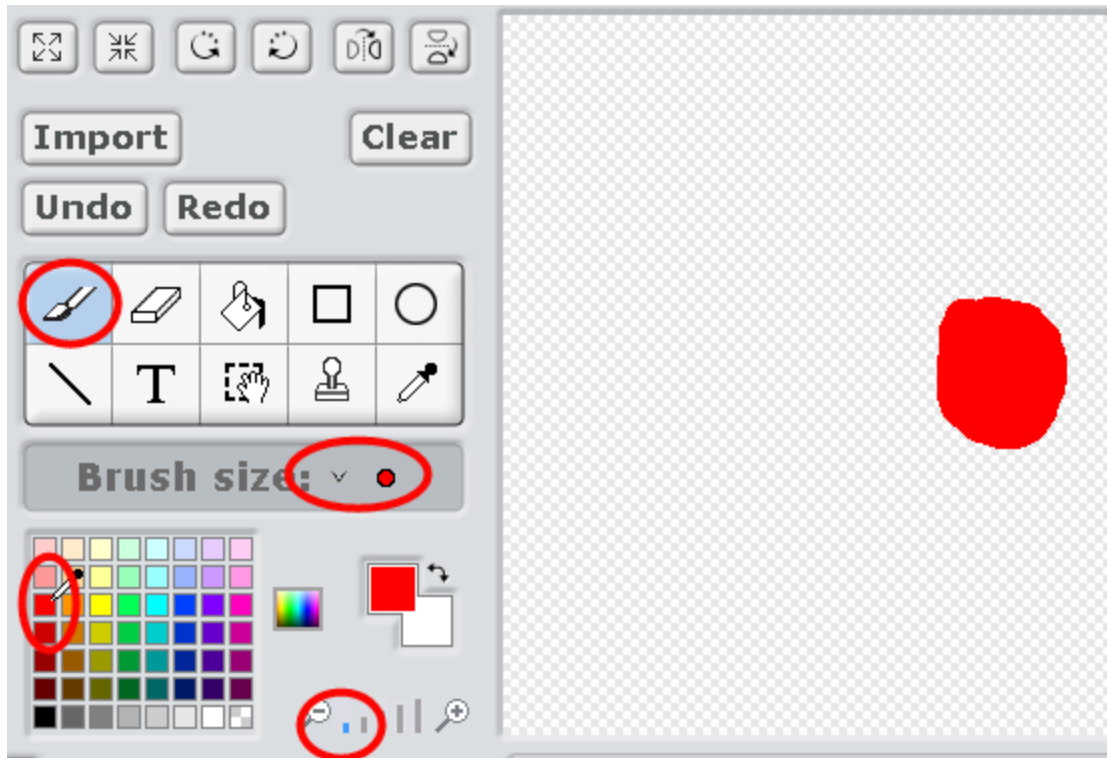


Let's draw the first sprite — the flower.

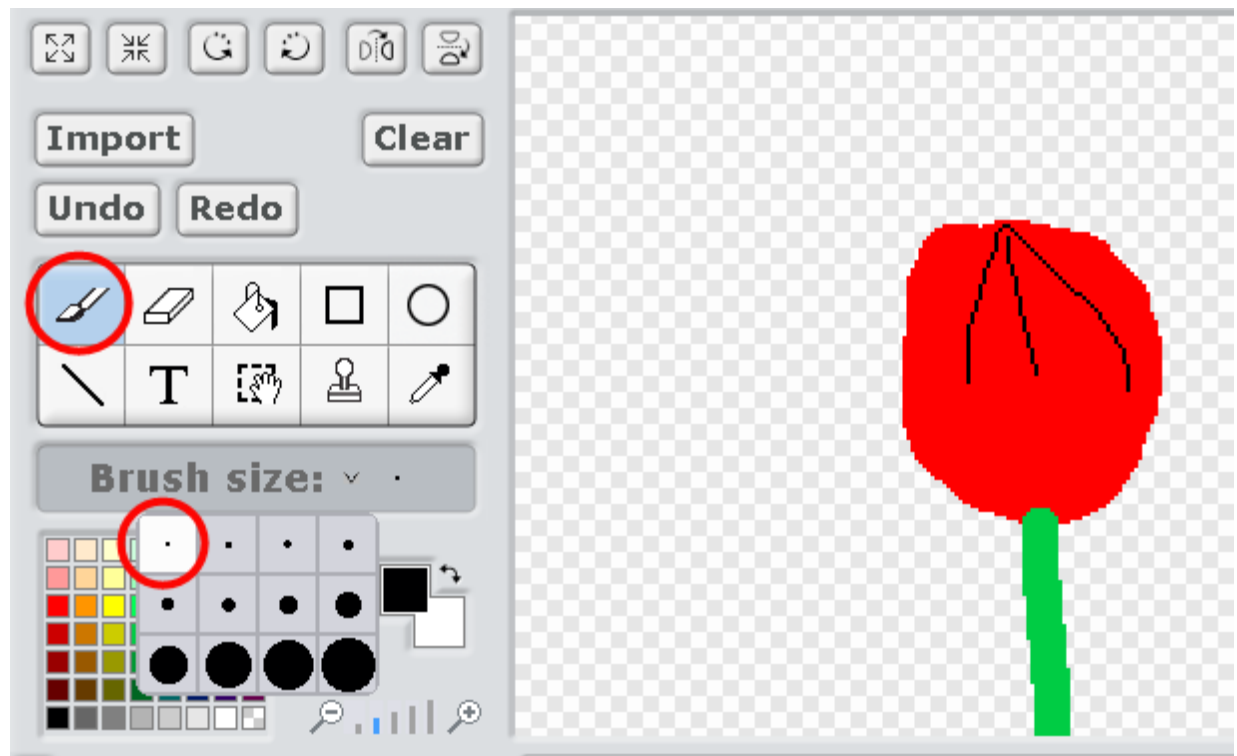


Before starting drawing change the scale. Click on the small blue stick.

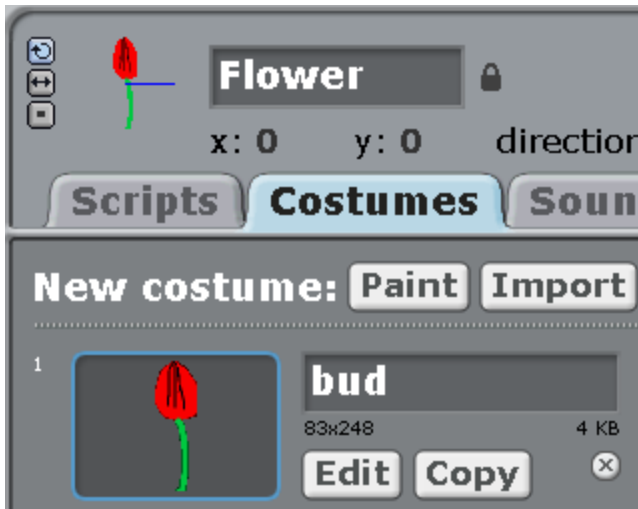
Then choose the brush and change the size of the brush. In order to do that, click on the small arrow. You will get a drop-down menu with the brush sizes. Choose the medium size.



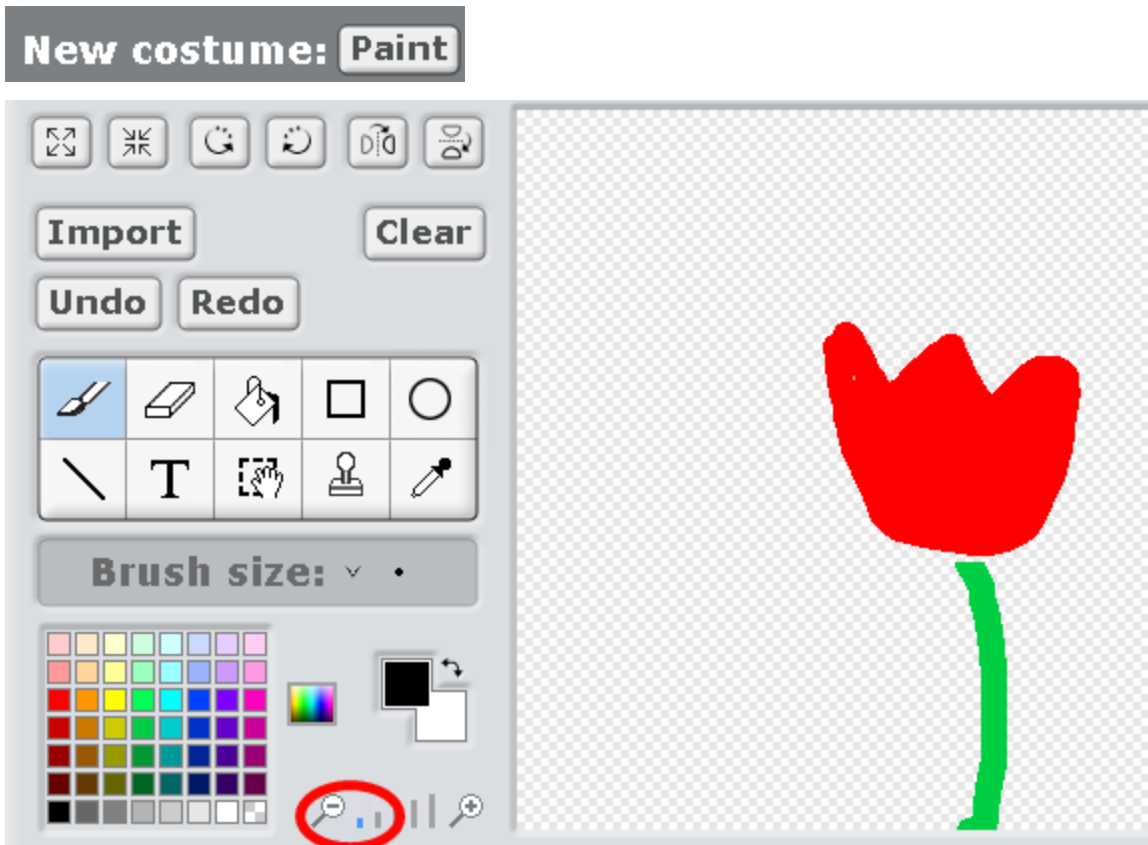
When you start drawing the black lines, choose a thin brush.



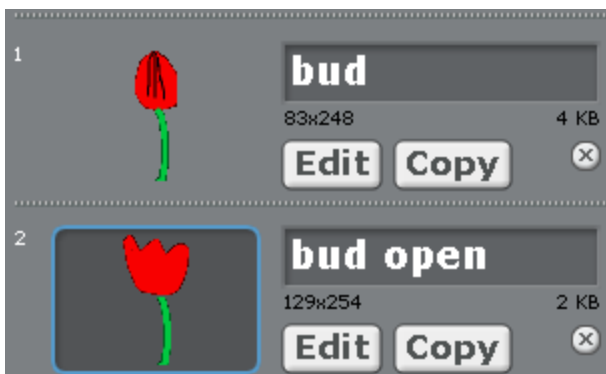
Let's give it normal names.



Let's draw the second costume — an open flower.



Let's give it a normal name.



The butterfly will have only three costumes: a kind, evil and very evil. Let's add a kind butterfly from the folder. Let's click on the folder with the star.



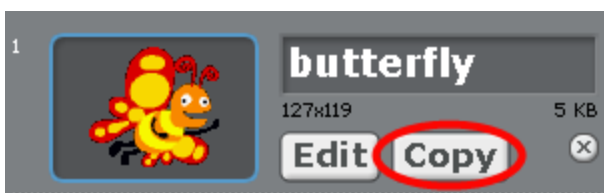
Let's choose butterfly2 in the folder Animals.



Let's click OK. Let's rename the butterfly.

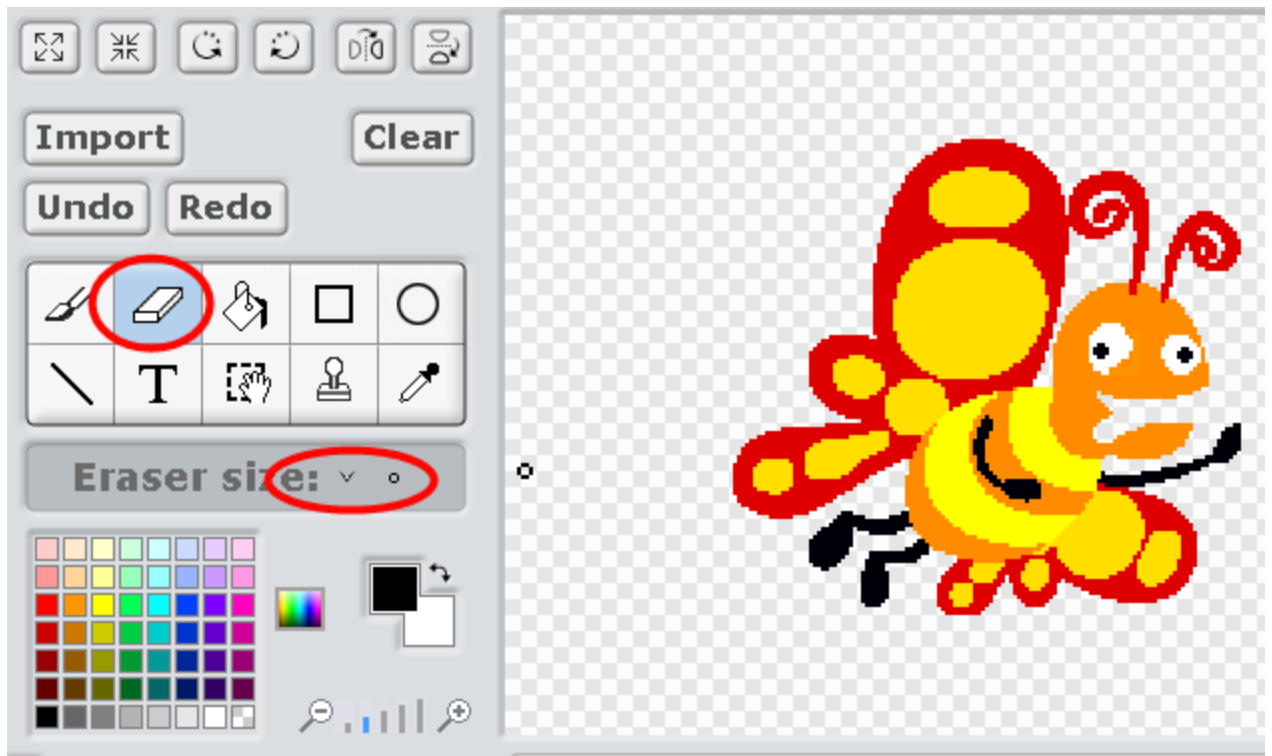


Click on «Copy».

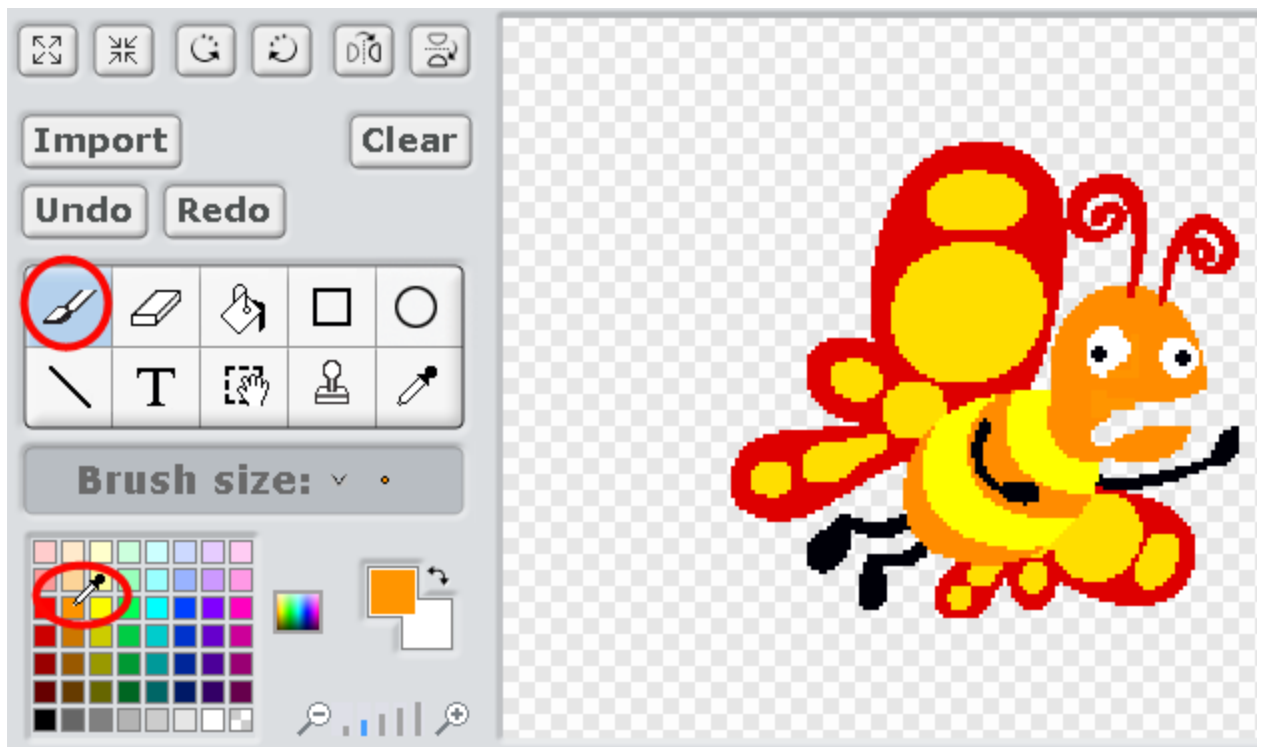


Let's make an evil butterfly from a kind one. In order to draw an evil mouth, choose an eraser and erase the mouth corner down. The size of the eraser is almost the smallest one.





Now add a cheek with the pencil. Choose orange. The size of the brush is still small.



Add evil lightning.



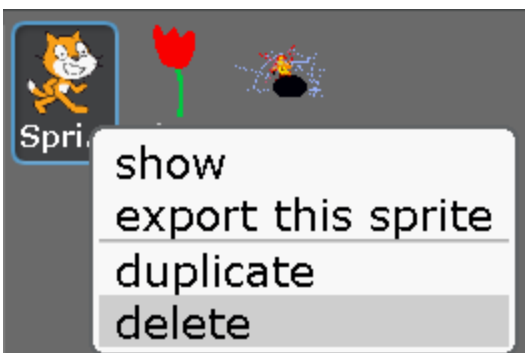
Then copy the evil butterfly.



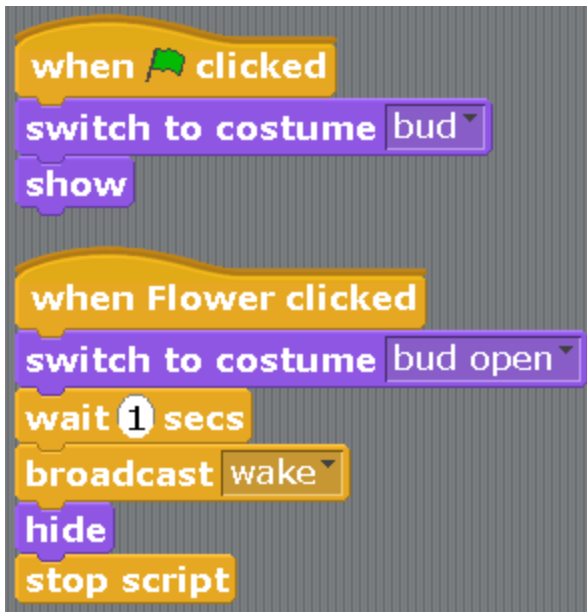
And then draw a costume of a veeery evil butterfly. It seems that she has even broken our monitor!



Now delete the Cat. You don't need it in this program. Right-click on it and choose «delete».



Now make a program for the Flower. We will use the block «when flower clicked» and «broadcast» in it for the first time. Let's broadcast the event «woke up».



When you put «broadcast» into the program, there is no event «woke up» yet. Click on the small triangle and on the «new...» one.



Insert the name of the event.

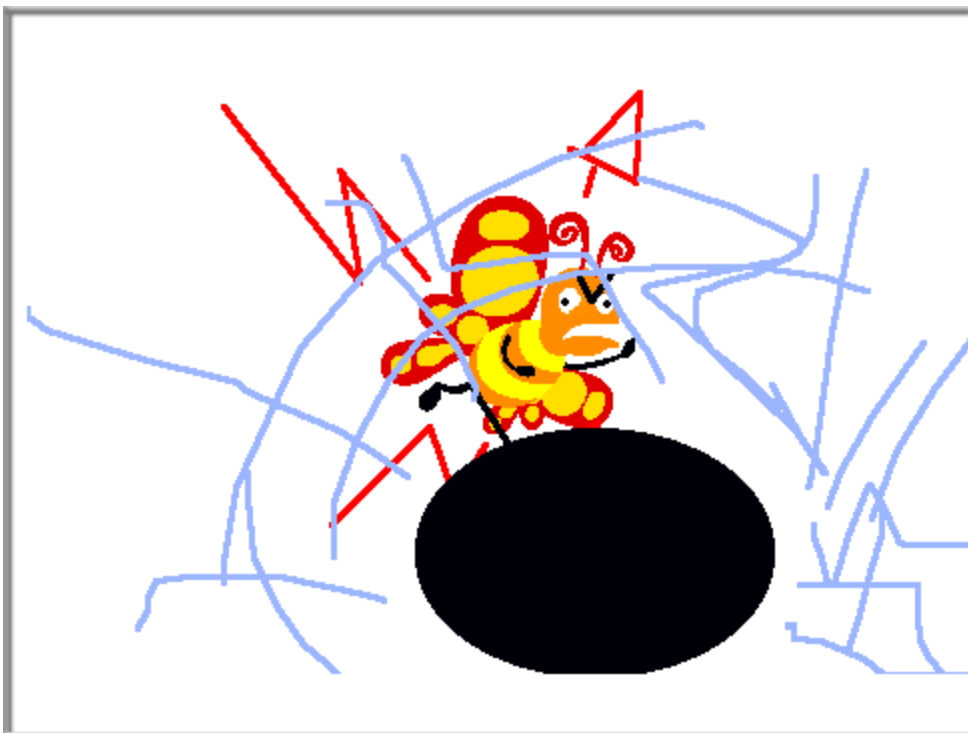


Make a program for the Butterfly. There is a new light blue block «ask» and «answer». When the Butterfly asks, you need to write in the text of the answer and click Enter. What you write gets into the oval «answer». If the answer is «No», the butterfly will say, «OK, I am flying away...» Whenever the answer is different, there will be an explosion of anger! That is why a new block «If/else» is used.

```
when clicked
  switch to costume butterfly
  hide

when I receive wake
  show
  ask Did you wake me up? and wait
  if answer = no
    say OK, I am flying away... for 2 secs
    hide
  else
    say Just you wait! for 2 secs
    switch to costume angry butterfly
    wait 1 secs
    switch to costume very angry butterfly
    wait 1 secs
```

Start the program. Click on the Flower. Write the response for the Butterfly. If you value your computer screen, write down «No». Otherwise, I am not responsible for the Butterfly.

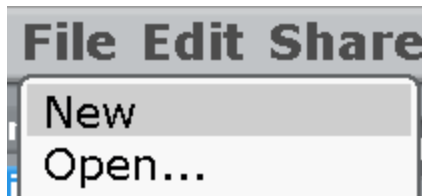


Do not tell your parents that a butterfly broke your monitor!

## Chapter 10. An animation cartoon about a bee.

Let's make a cartoon about a Bee. The Bee is flying and flapping her wings.

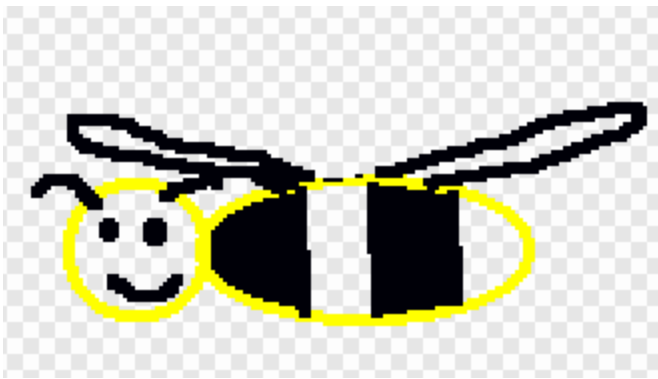
Let's create a new project.



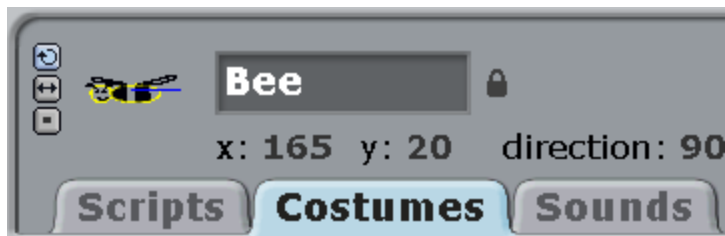
Let's add a new sprite.



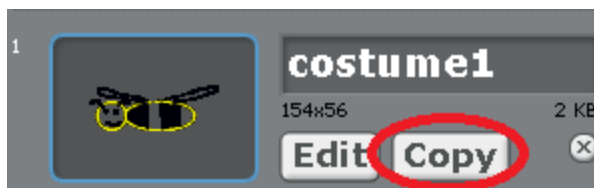
Let's Draw a Bee.



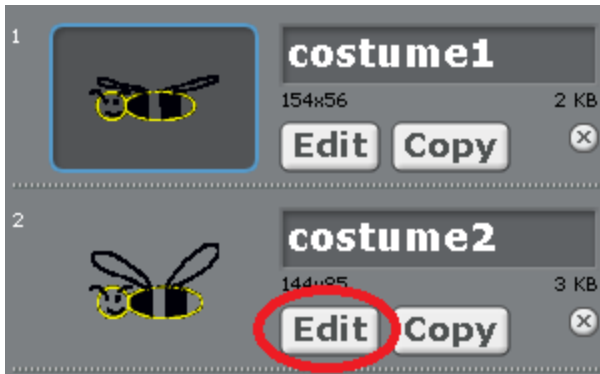
Let's re-name it.



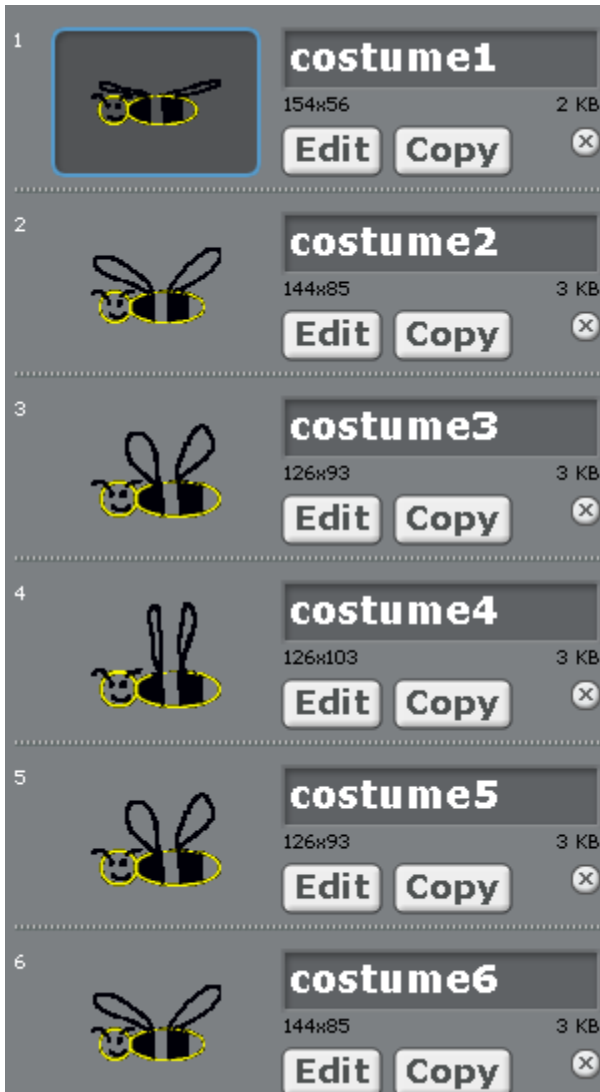
Let's click on «duplicate».



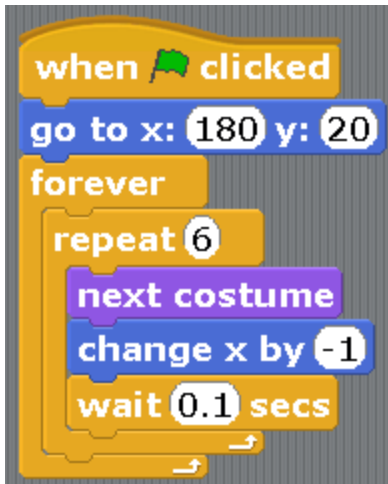
We will get the second costume, a copy of a Bee. Click «Edit» on it.



Change only the Bee's wings. Draw 6 costumes this way.



The Bee program is very simple. Let's take all the costumes one by one.



The block «change x by -1» means movement to the left. The block «go to x:180 y:20» means moving to the right side of the screen.



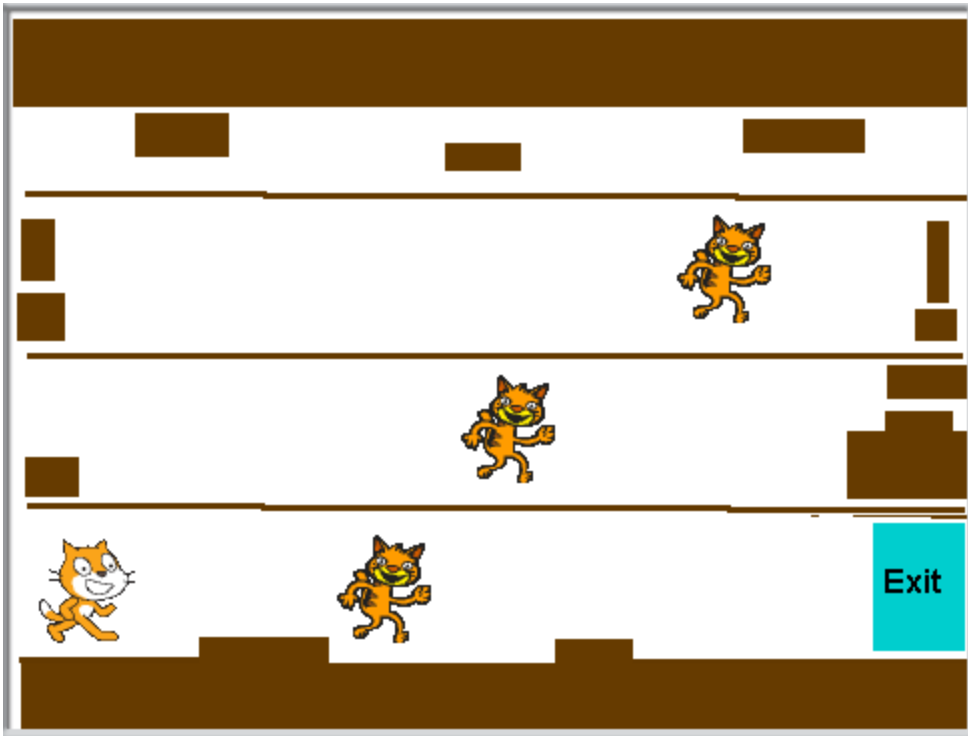
It can fly in such a cool way!

A question: how can we make the flight faster?

A task: add the music.

### Chapter 11. Playing on two levels.

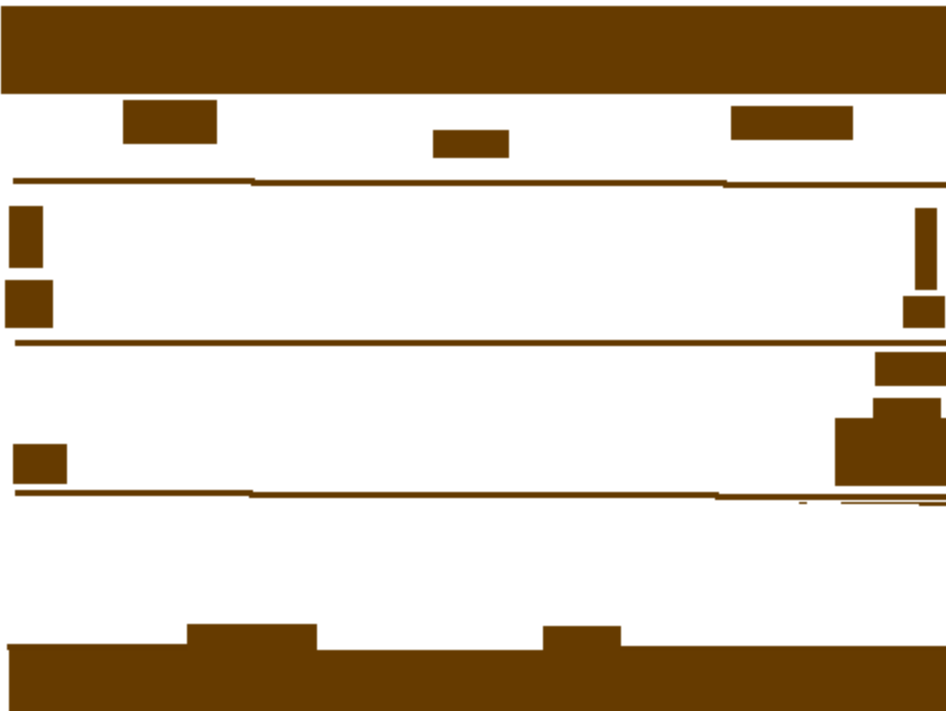
In this game the Cat needs to get to the Exit. There are three enemies running on the level. If the enemy touches the Cat, the Cat will restart the game. When the Cat gets to the Exit, the game will switch to the second level. The cat is controlling the arrows.



Create a new project. Don't rush to add characters. First, draw two levels and Victory on the stage. Choose the stage. Click on «Paint» on the «background» tab.



Draw three costumes. Costume background 1.



Costume background 2.





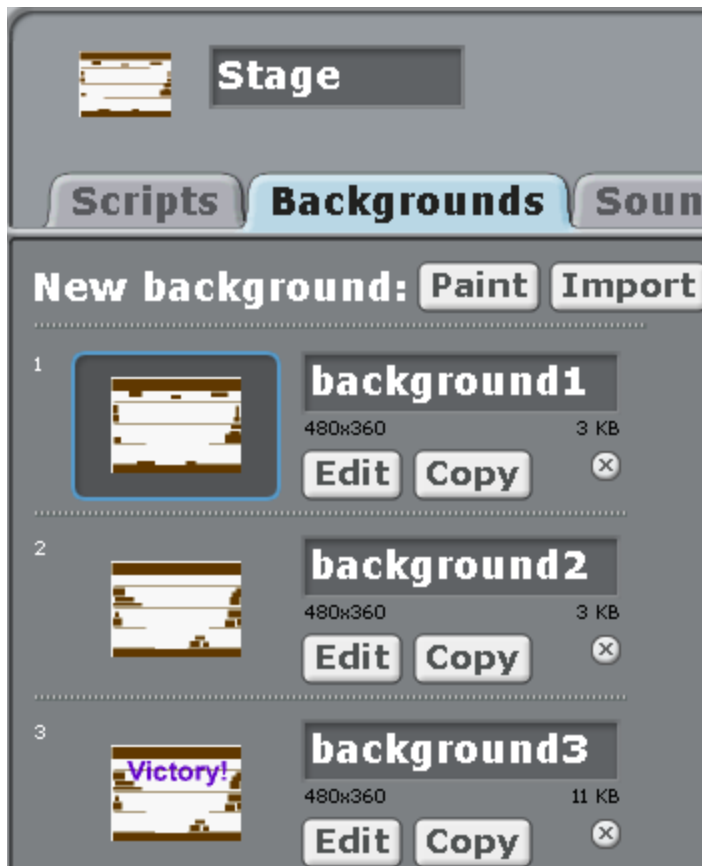
Costume background3. It will appear when the Cat will go through the whole game.



**Victory!**



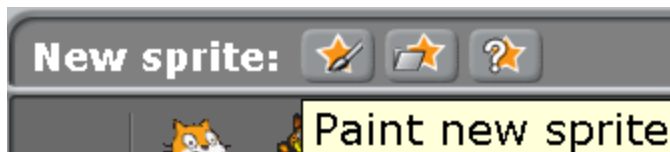
You will get the following scene.



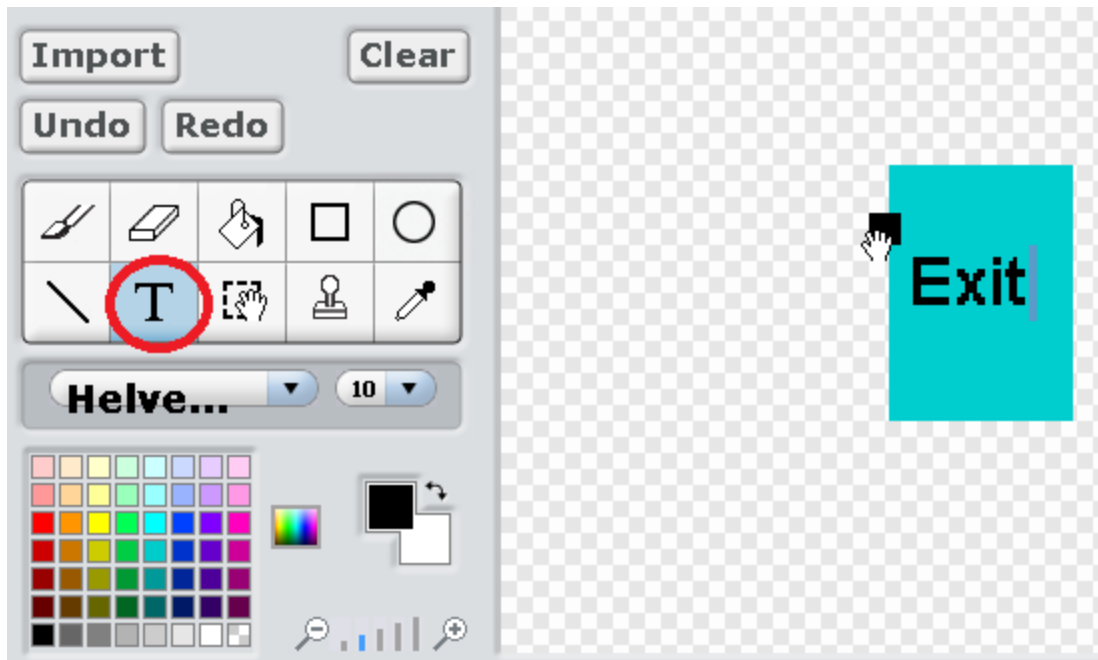
There will be 6 characters (sprites) in the game in total: the Cat, three enemies and two doors. The door Exit1 is the transfer to the second level. The door Exit2 is the victory.



Draw the sprite Exit1.



Let us draw a rectangle. In the center there will be a message «Exit». If the message turned out not in the center, you will need to drag it. Place the cursor on the black square near the word and drag the word to the center of the rectangle.



Don't forget to give the door a normal name, for example «Exit1».



The same way let's draw the second door and call it «Exit2».



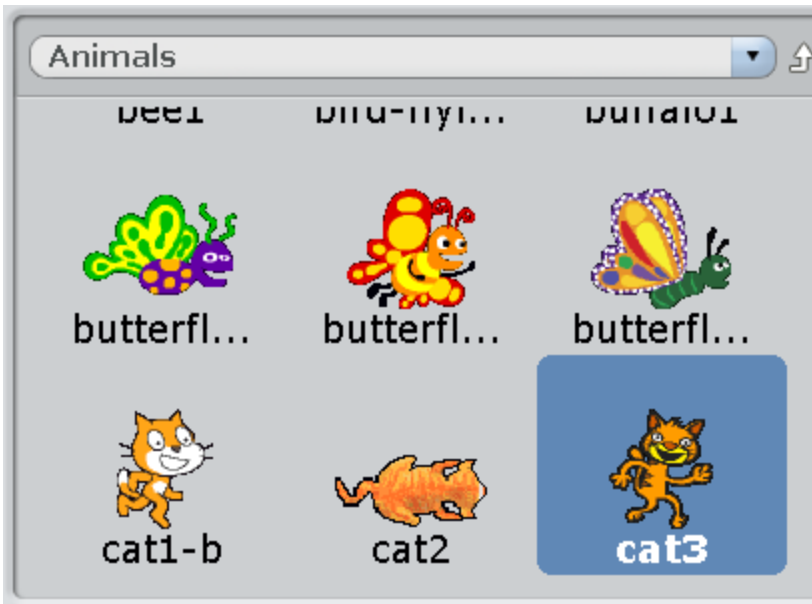
Place the doors exactly one over another. If they are a bit too big, make them smaller by clicking on the shrinking button over the screen, then on the door.



Now let's add one Enemy. Let's write a program for him, and then duplicate him twice and we will get three Enemies. Let's click on the folder with a star.



Let's choose the character cat3 in the folder Animals.



Let's rename him into «enemy1».



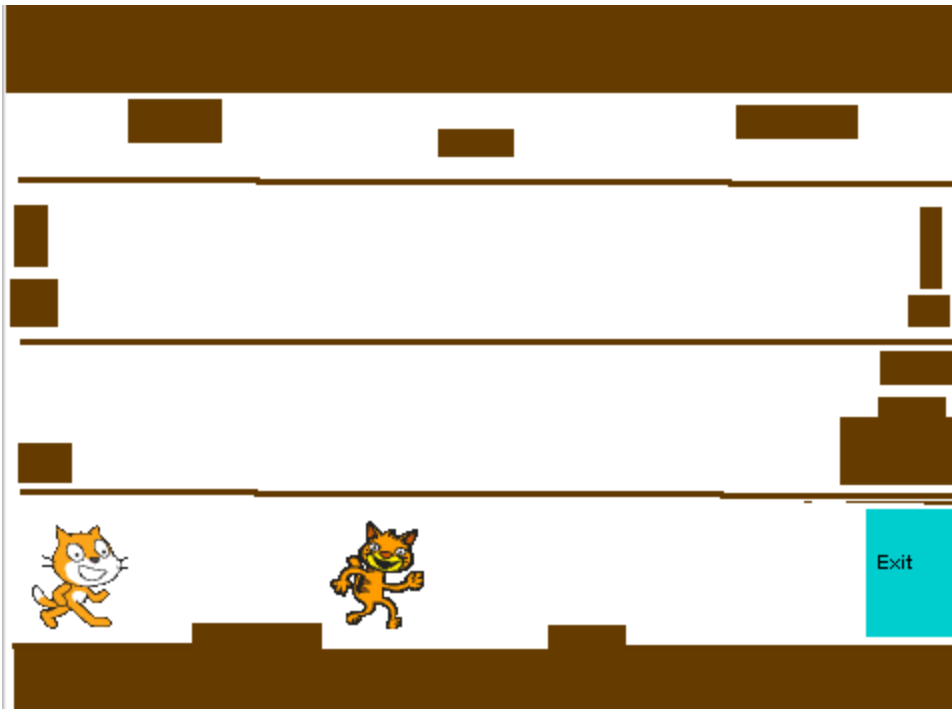
Notice that both our Cat and Enemy1 are a bit too big for this labyrinth. Click the button of reduction over the screen.



Then click on the Cat and he will get smaller. The same button exists in the drawing program.



Place the Cat and enemy1 the same way as in the picture — on the first floor.

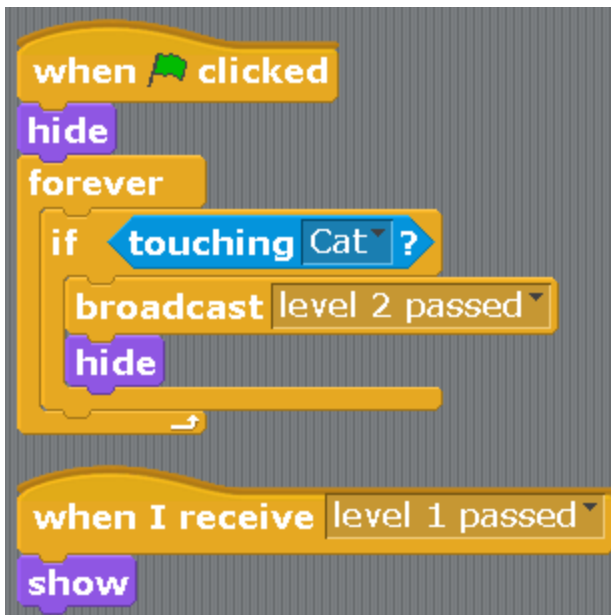


Now we have three backgrounds and 4 sprites.

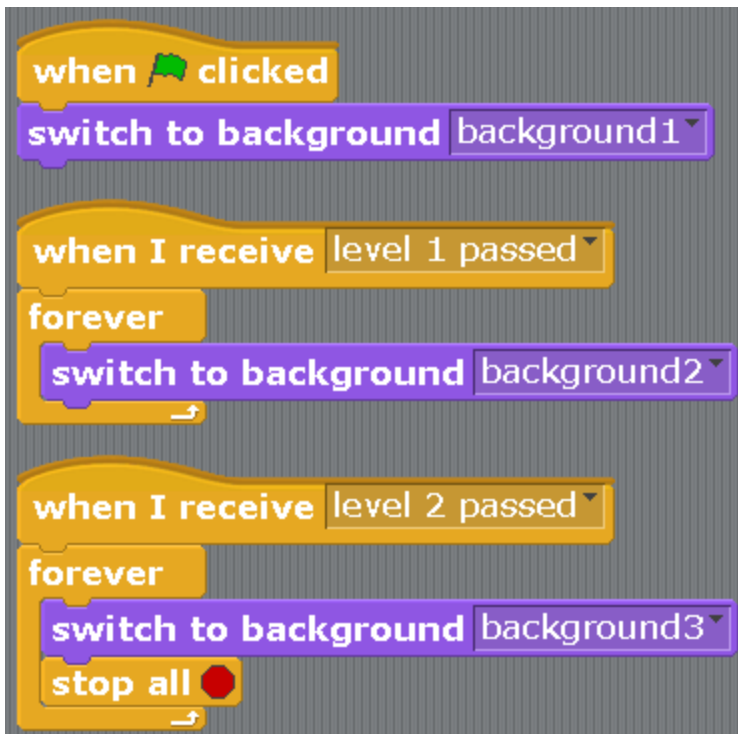
Let's make a program for the first door — Exit1.

```
when clicked
  show
  forever
    if touching Cat ?
      broadcast level 1 passed
      hide
  when I receive level 2 passed
    hide
```

Let's make a program for the second door — Exit2.



Let's make a program for the Stage.



Let's make a program for the Cat. The first script.

```
when clicked
show
go to x: -200 y: -110
forever
if touching enemy1 ?
go to x: -200 y: -130
play sound Meow
if touching enemy2 ?
go to x: -200 y: -130
play sound Meow
if touching enemy3 ?
go to x: -200 y: -130
play sound Meow
if touching color ?
go to x: -200 y: -110
play sound Meow
```

There are 6 more scripts for the Cat.

```
when up arrow key pressed
change y by 80

when down arrow key pressed
change y by -80

when right arrow key pressed
change x by 5

when left arrow key pressed
change x by -5

when I receive level 1 passed
go to x: -200 y: -110

when I receive level 2 passed
hide
```

The program for the first enemy — Enemy1.



```

when clicked
show
go to x: -70 y: -110
forever
repeat 100
  move 1 steps
wait 1 secs
repeat 100
  move -1 steps
wait 1 secs

when I receive level 2 passed
hide

```

Now let's right-click on Enemy1 and duplicate him.



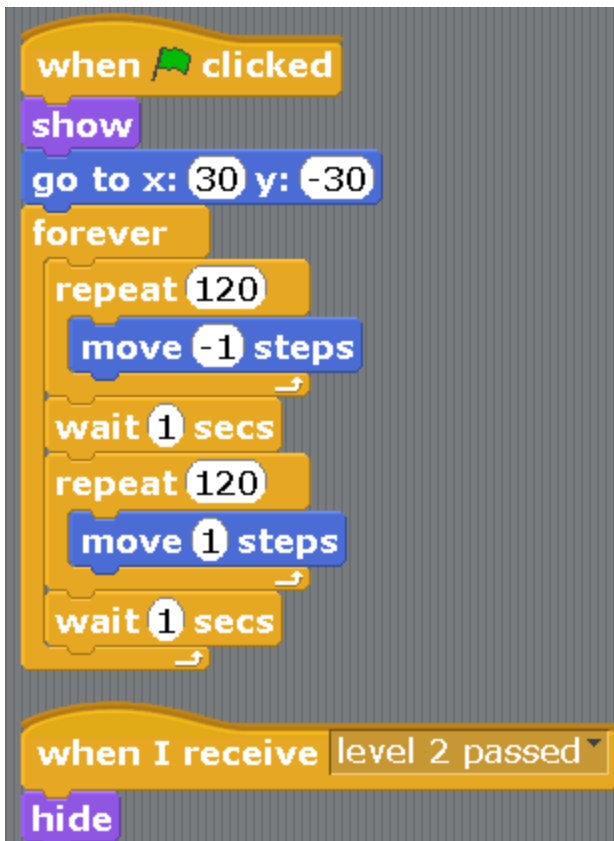
Then one more time.



We've got three enemies in total. Rename them into Enemy2 and Enemy3.



Enemy2 and Enemy3 have the same programs as Enemy1. Change the program for Enemy2. It should be like that.



The program differs by the number of repeats and the direction of the movement. At first, the character is going to a point with other coordinates x and y. The program Enemy3 should be like that.

```
when clicked
show
go to x: 100 y: 50
forever
repeat 110
move 1 steps
wait 1 secs
repeat 110
move -1 steps
wait 1 secs
when I receive level 2 passed
hide
```

It also differs by the number of repetitions and the direction of movement. And the coordinates of the location of the characters x and y.

Everything is ready. Start the game.

### [Chapter 12. A game about a magician.](#)

The Magician has some old scores to settle with the Witch. To the left, there are several jars with magic potions. Clicking on different potions, various magical spells are placed on the Witch.



Create a new program. Load the Magician and the Witch from the Fantasy folder.



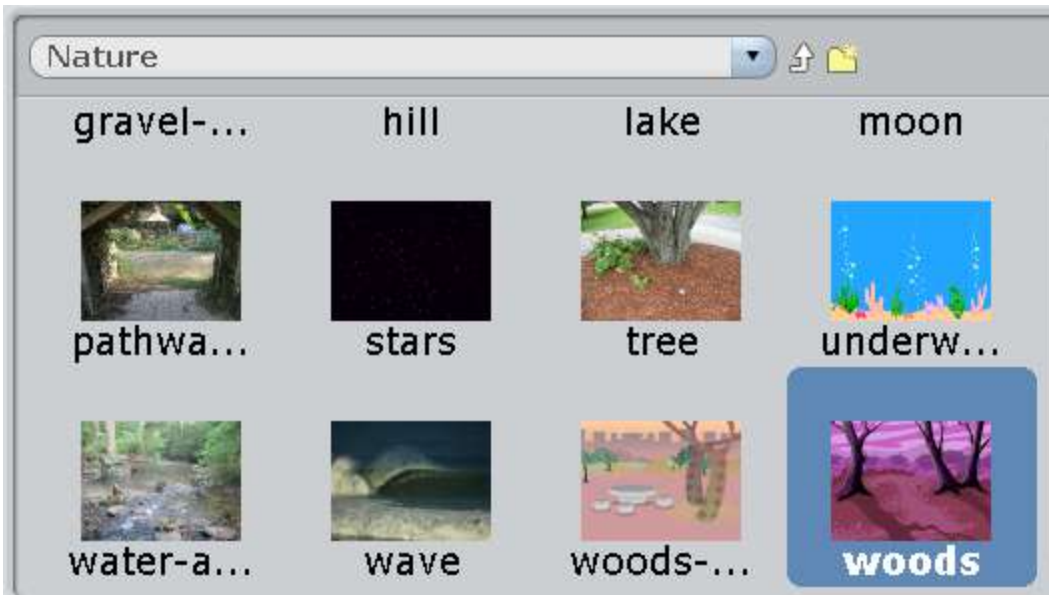
Rename them.



Place the Witch facing the Magician.



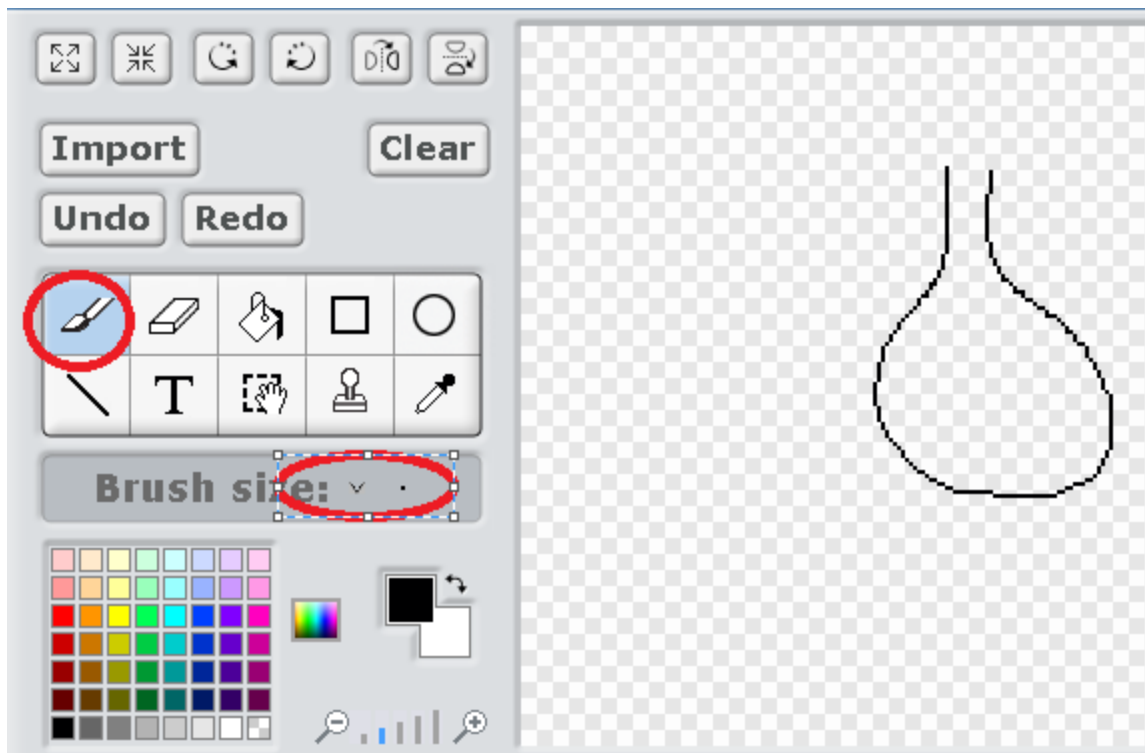
Load the background on the stage. There are a lot of interesting backgrounds in the Nature folder.



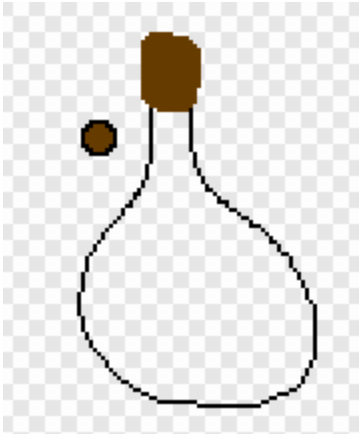
Now we need to draw five magical objects. You can try to draw a book, or a bag with magic powder. Or some other magical artifact.



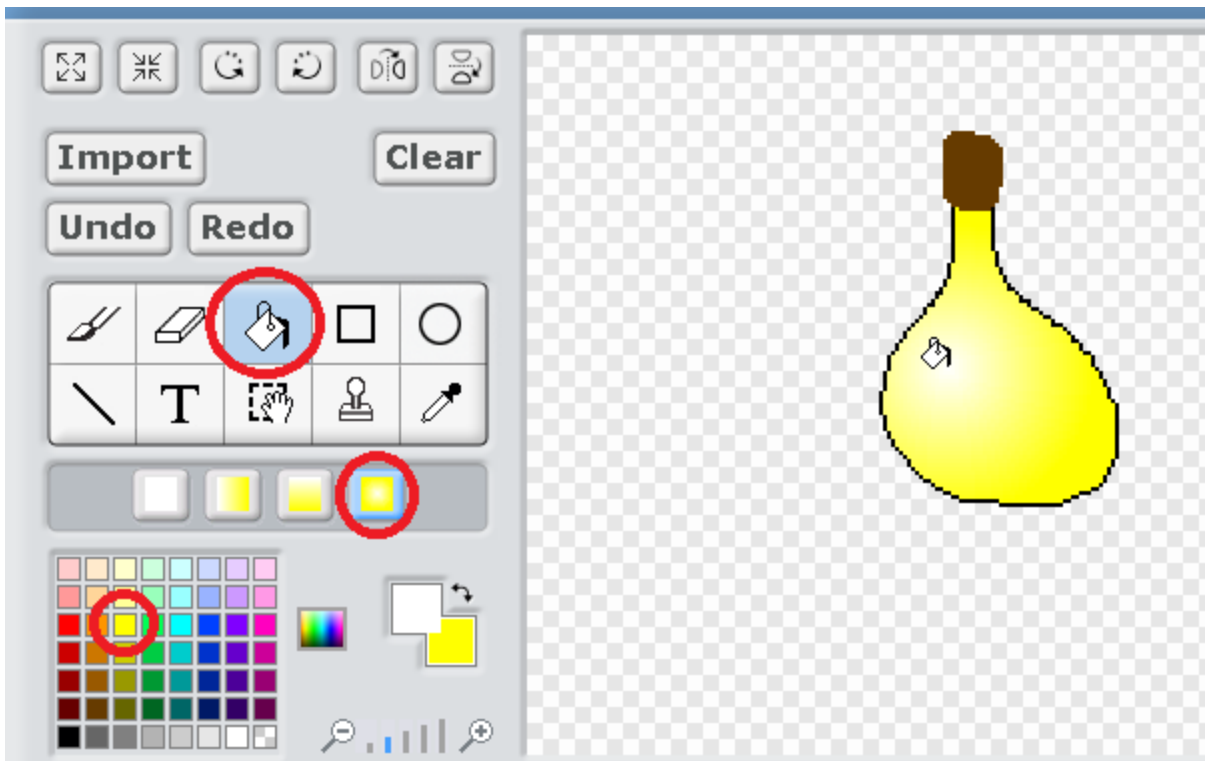
Draw a bottle with a thin brush.



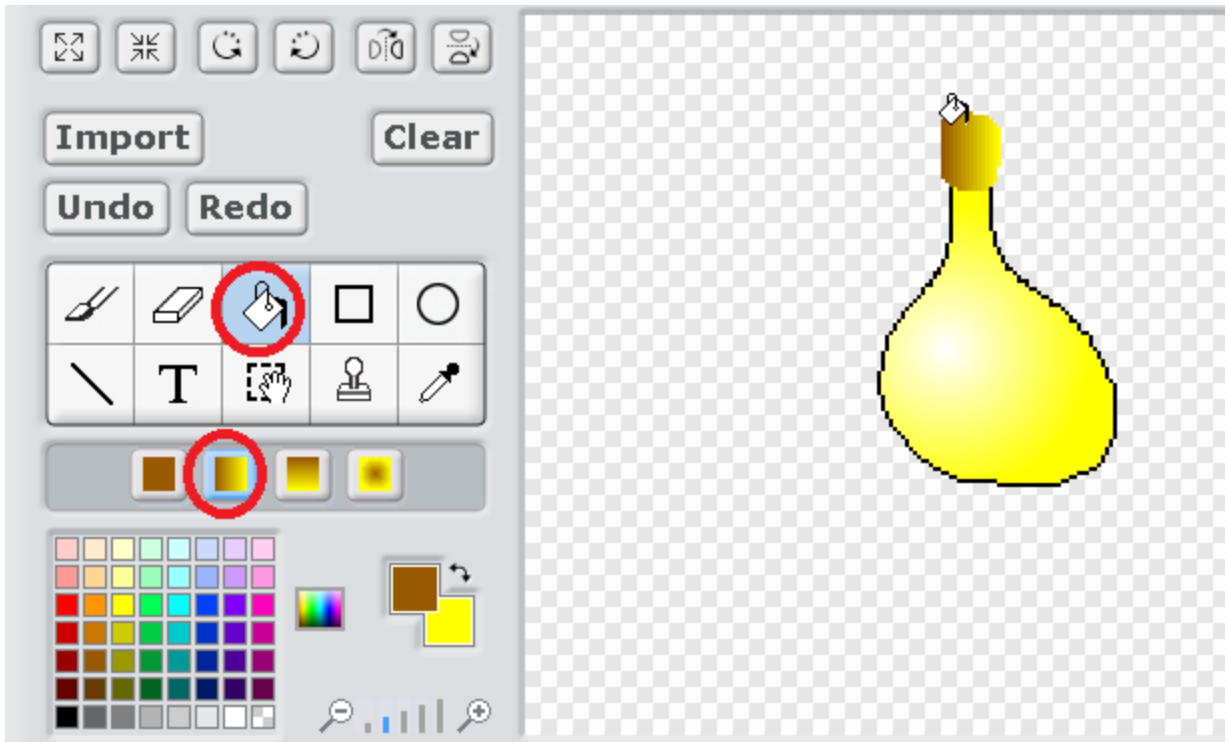
Draw a cork with a thick colored brush.



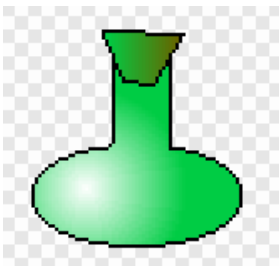
Then choose circular filling with yellow color.



Now let's make a pretty cork. Choose vertical filling, choose the colors and click on the cork.



Draw four more artifacts.



I got two potions in total, a green flask, a bag and a bone.



Not a bad set for a young Magician!

Let's start the spells. Each magical object transmits an event. Make the following program for potion1.



For potion2.



For the flask.



For the bag.



For the bone.



For the Magician.



```
when clicked
switch to costume Magician1

when I receive stone
switch to costume Magician2
say Turn into stone, the evil one! for 1 secs
switch to costume Magician1

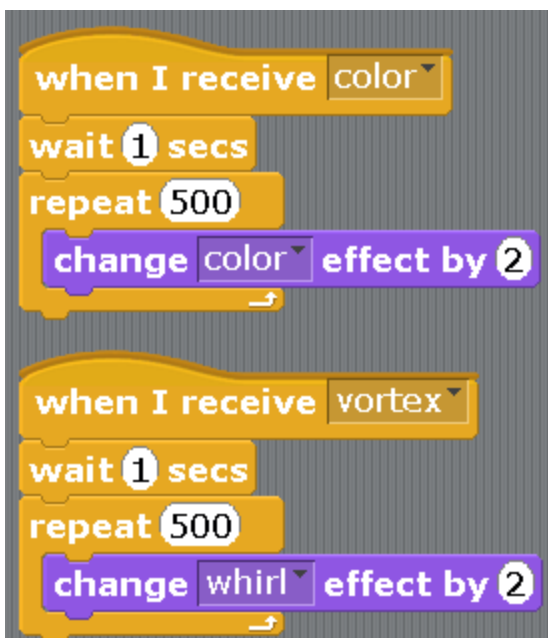
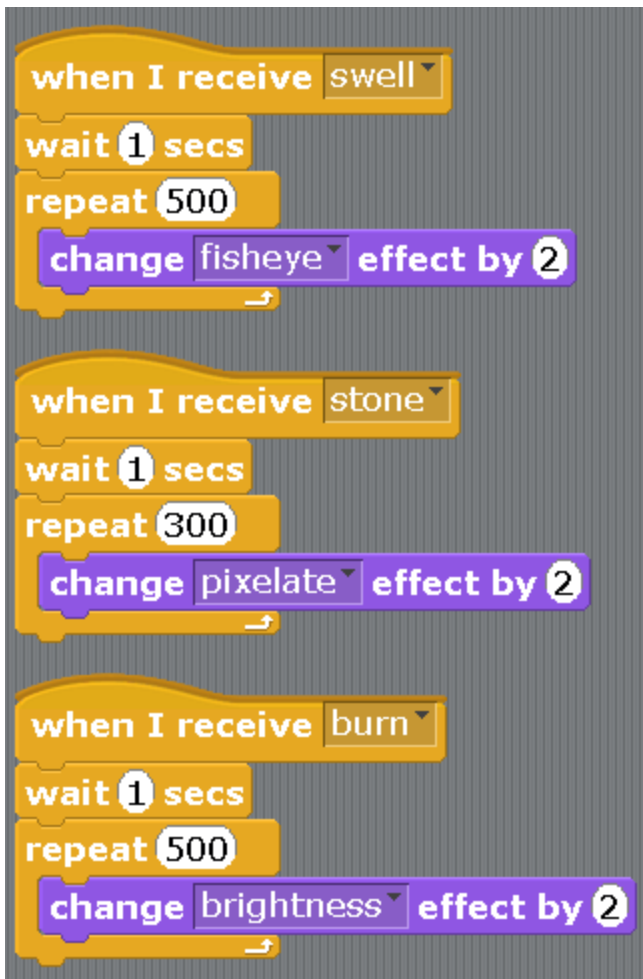
when I receive swell
switch to costume Magician2
say I wish you would burst! for 1 secs
switch to costume Magician1
```

```
when I receive color
switch to costume Magician2
say Drink from the flask! for 1 secs
switch to costume Magician1

when I receive vortex
switch to costume Magician2
say Turn until you break down! for 1 secs
switch to costume Magician1

when I receive burn
switch to costume Magician2
say Burn, the Witch! for 1 secs
switch to costume Magician1
```

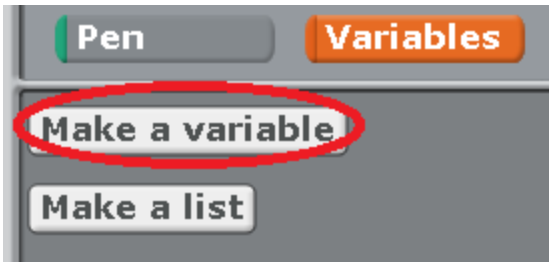
For the Witch.



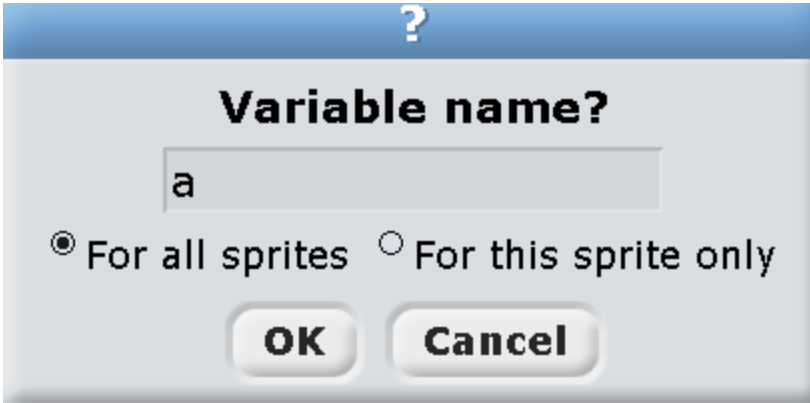
Click on the magical objects. The Witch is going to have a hard time!

### [Chapter 13. The Cat-mathematician.](#)

The Cat goes to school, got very good grades and became a mathematician. Now he can add any two numbers. We will use variables in this program. In order to create a variable, click on the orange blocks and the button «Make a variable».

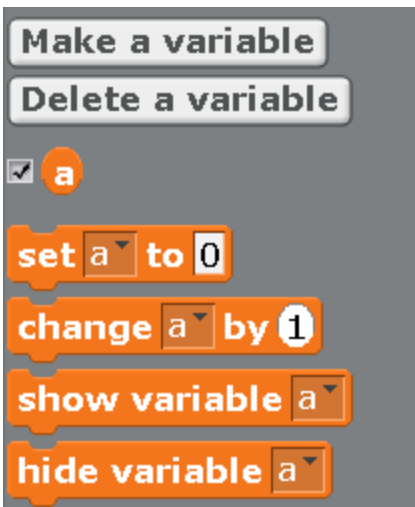


Input the name of the variable. For example, «a».

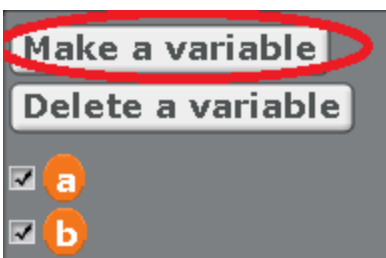


Always check next to «For all sprites».

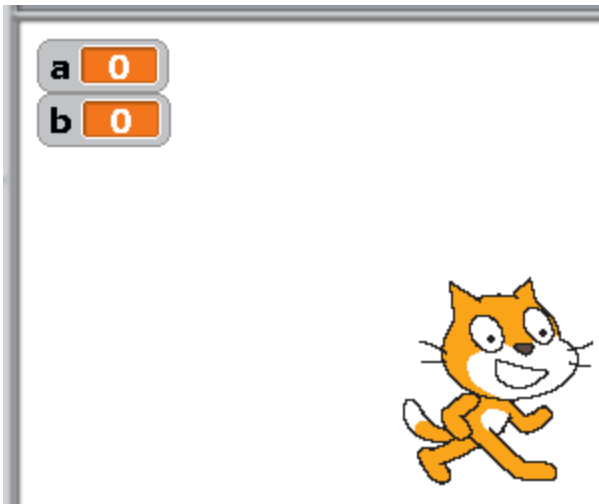
The variable «a» as well as several orange blocks will appear.



Create another variable «b».



If there are check-marks next to the variables, the values of the variables will be shown on the screen.



A variable is a cell of computer memory that can remember numbers. For example, if we use a block «set a to 0», the variable a will store zero.

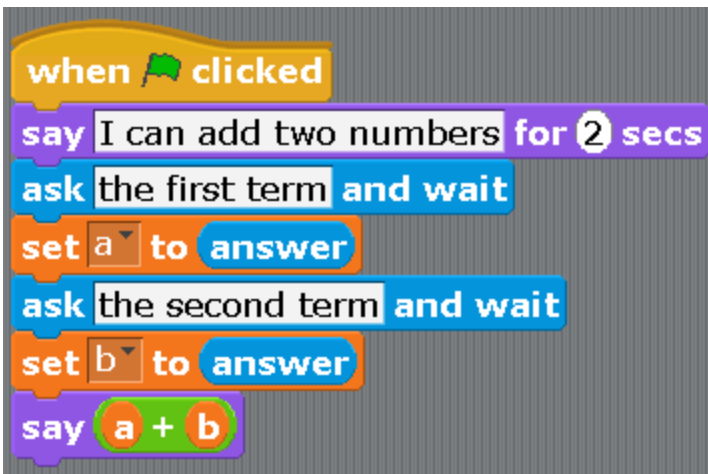


This zero will be stored there until we use the block «change a by 1». Then the variable «a» will have number one in it.

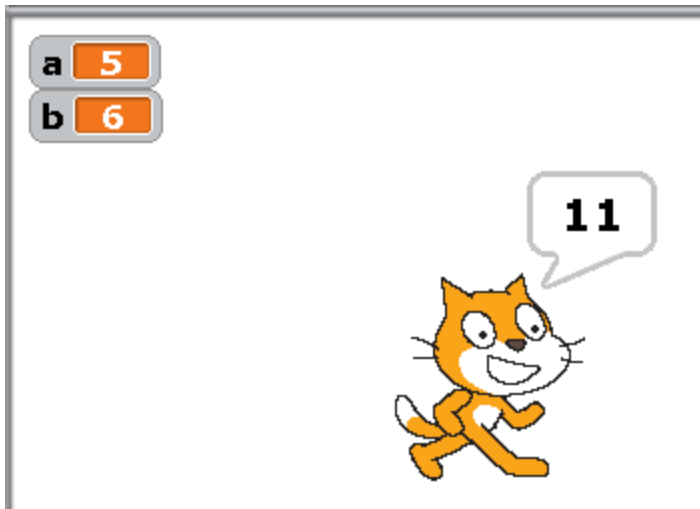


If we use the block «change a by 10» after that, then the variable a will have number eleven in it.

Now let's teach the Cat to add numbers. Make the following program for him. You can find the green addition block in the «operator» blocks. The light blue blocks «ask» and «answer» can be found in the «sensing» blocks.



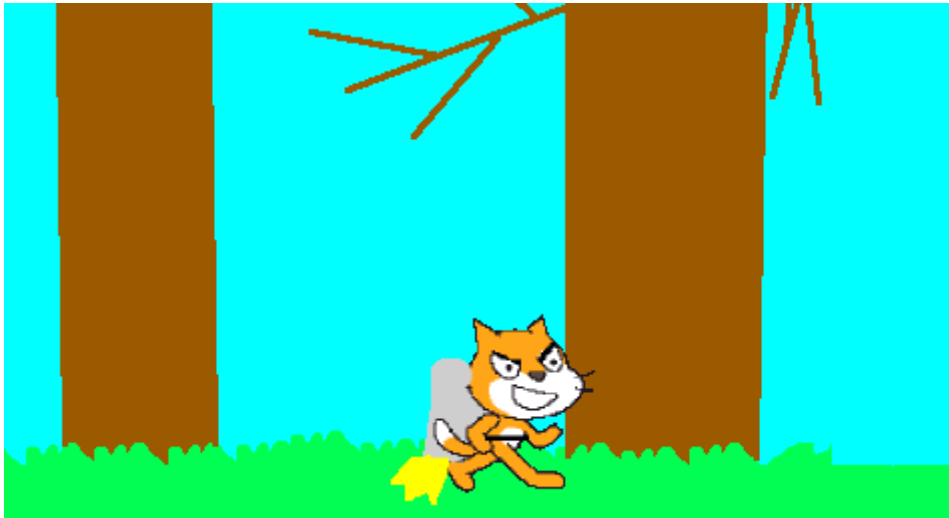
When the Cat asks about the first add-end, input the number in the line and click Enter (you can click on the check-mark).



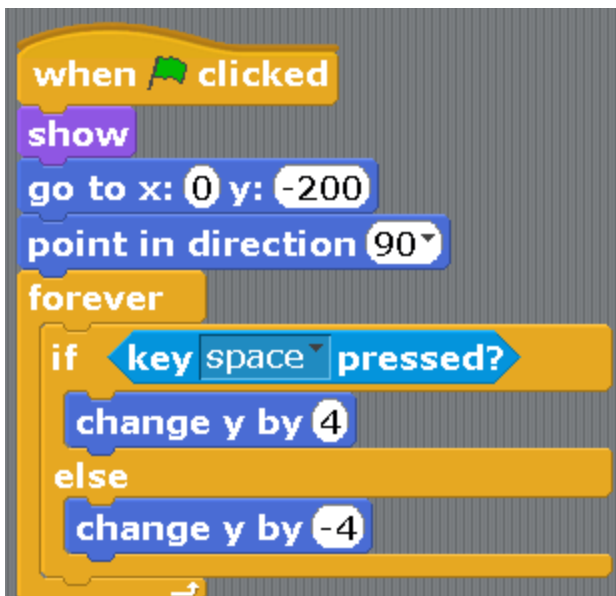
You've got 11! What a smart Cat.

[Chapter 14. The game «A Cat with a jet-propelled backpack».](#)

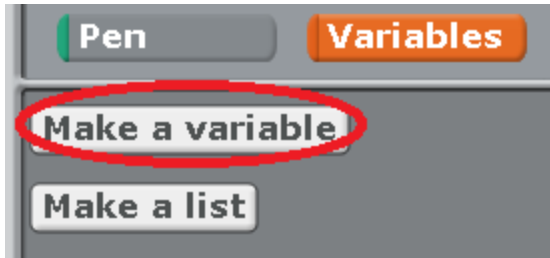
Part 1. What steady motion and motion with acceleration are.



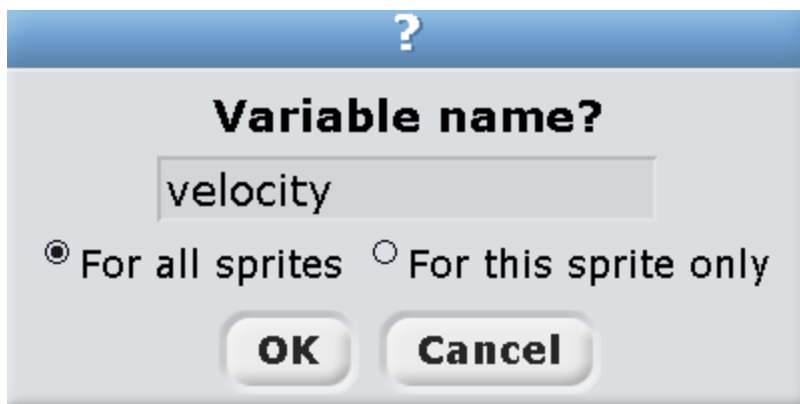
Create a new project, draw a jet-propelled backpack for the Cat. Draw the background. Make the following program for the Cat.



We are using the block «If-else» here. If the space bar is pressed, then we are moving up (more about movement in Appendix 2), otherwise, if you have let the space bar go, the Cat is falling down. Start the program. The Cat's movement is not natural. In reality, when the jet-propelled backpack is turned on, the Cat first moves slowly, then faster and faster, moves with acceleration. You can feel the movement with acceleration when a car or a plane speeds up and you become pressed to the back of your seat. Now erase the Cat's program (drag it to the left to the blocks). Create a variable «velocity».



Always check next to «For all sprites».



Make the following program for the Cat.



If the space bar is pressed, then we move up with acceleration, otherwise, if you release the space bar, the Cat will fall down with acceleration. Note that the acceleration up is 0.5, and the acceleration down is two times less than the one up — 0.25. That means that the Cat is going down slower than he is flying up. Read more about the numbers with a dot in [Appendix 4](#).

Part 2. Let's add problems for the Cat. Let's make flying logs. The logs will be flying from right to left. The Cat has to be able to turn away. Add a second costume for the Cat. This costume will show up when the Cat can't turn away.



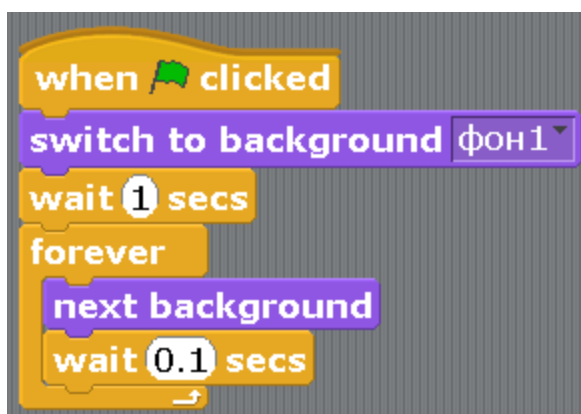
Draw three logs.



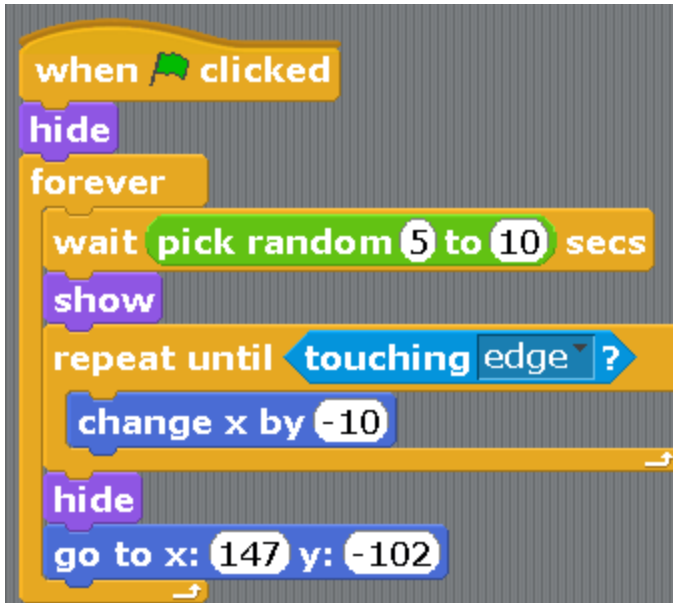
Draw three backgrounds.



Make the following program for the stage. The backgrounds will change 10 times per second. If you think that this is too fast, change the delay of 0.1 seconds to 0.2 or 0.3.

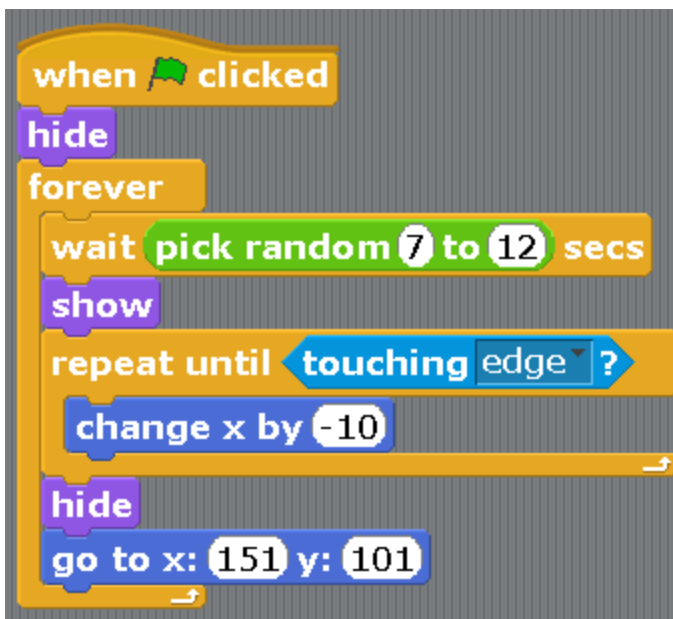


Make a program for the first log — log1. The log appears with a random delay of 5 to 10 seconds. It flies from right to left and disappears. In order to increase the dynamics of the game, you can change 5 and 10 to 3 and 6, or to 2 and 4.



```
when clicked
hide
forever
wait pick random 5 to 10 secs
show
repeat until touching edge ?
change x by -10
hide
go to x: 147 y: -102
```

The program of the second log is log2. This log appears less often than the first one (the delay is from 7 to 1 seconds) and flies lower than the first one.



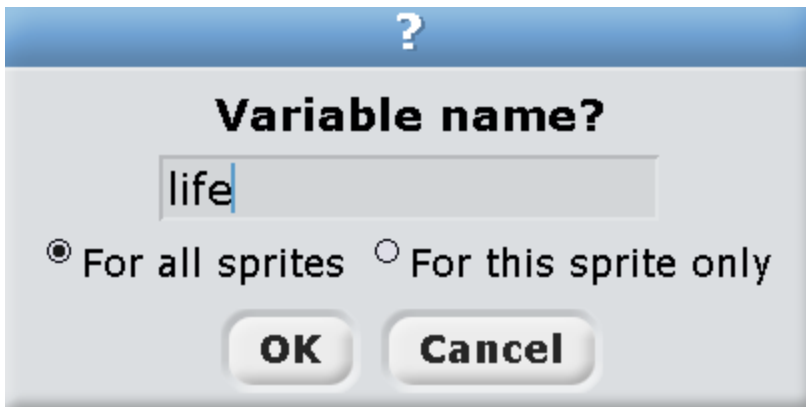
```
when clicked
hide
forever
wait pick random 7 to 12 secs
show
repeat until touching edge ?
change x by -10
hide
go to x: 151 y: 101
```

The program of the third log is log3. This is the log that appears less often than any others. The delay of appearance is from 12 to 18 seconds. And the most dangerous thing. It constantly turns (the block «always turn by 15 degrees»).





Now let's fix up the program for the Cat. It will contain three scripts. Finish up the first script — the script of the flight. Create another Life variable. At the beginning, the Cat has 4 lives. They reduce from colliding with logs.



Work more on the first script.

```
when green flag clicked
  set velocity to 0
  set life to 4
  switch to costume Cat
  set y to 0
  set size to 85 %
  point in direction 90
  show
  forever
    if key space pressed?
      change velocity by 0.5
    else
      change velocity by -0.25
    change y by velocity
```

Add the script of meeting the log.

```

when clicked
  forever
    if touching beam1?
      change life by -1
      switch to costume Ouch
      wait 1 secs
      switch to costume Cat
    if touching beam2?
      change life by -1
      switch to costume Ouch
      wait 1 secs
      switch to costume Cat
    if touching beam3?
      change life by -1
      switch to costume Ouch
      wait 1 secs
      switch to costume Cat
  
```

Add the final script. If the Cat has zero lives, he will fly away forever, rotating crazily.

```

when clicked
  forever
    if life = 0
      switch to costume Ouch
      repeat 100
        turn 15 degrees
        change size by -1
      hide
      stop all
  
```

Start the game. Control the jet-propelled backpack using the space bar.



A question: how can we make the log fly faster?

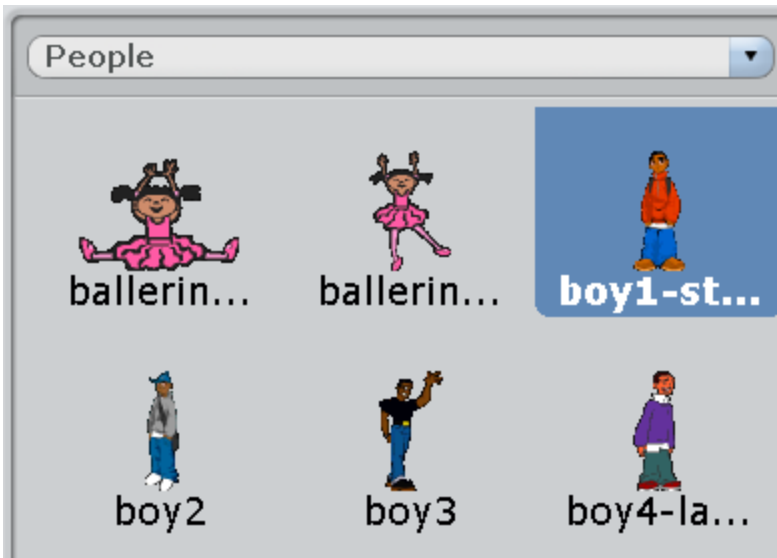
A task: do it so that all three logs rotate in flight.

### Chapter 15. Communicating with the character.

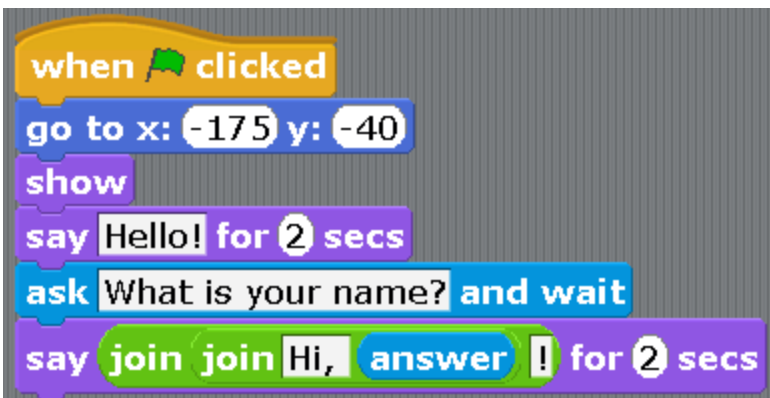
I am going in the school, not bothering anyone, all of a sudden, there is a completely new student going towards me. We talked for a little bit.



Create a new project, add the background and some person from the folder People.



Make the following program for him.



We are already familiar with the block «ask and wait». We have used it in the program about the evil butterfly. A new block «join» appeared here. It connects words. In our case it connects the word «Hello» and the name, that you have input when you were answering the question. In order to get this complex block, first drag three blocks in the workspace, «say», «join», «answer».



Then drag the answer and put it in instead of the word «world».



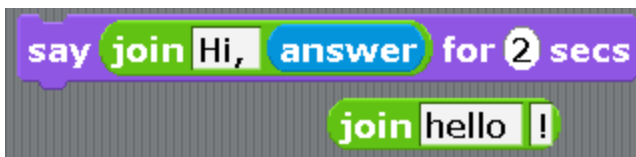
Then drag «join» and put it instead of the word «Hello!»



Start the program. Write the name and press Enter.



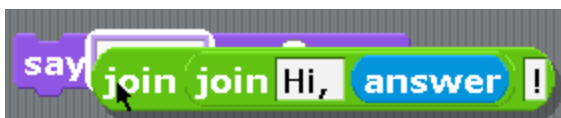
The boy will say, «Hello Vasisualiy». Note that after the word «Hello» there is a space. If it is not there, the words will be written together, «HelloVasisualiy». Let's add an exclamation mark at the end, because the boy is happy to see us. Drag one more block «join» to the working area. Exchange the word «world» for an exclamatory mark «!».



Take the green block «join» from the block «say» with the answer inside, and put it instead of the word «hello» in the new block.



Drag the double block «join» into the violet block «say».



Return the block «say» to the same spot after the block «ask». The following program will come up.

```
when clicked
go to x: -175 y: -40
show
say Hello! for 2 secs
ask What is your name? and wait
say join join Hi, answer ! for 2 secs
```

Start it. It speaks well.



Let's continue writing the dialogue (a dialogue is a conversation between two speakers). Add a phrase, «How old are you? Seven? And I thought eight...».

```
when clicked
go to x: -175 y: -40
show
say Hello! for 2 secs
ask What is your name? and wait
say join join Hi, answer ! for 2 secs
ask how old are you? and wait
say join I thought answer + 1 for 2 secs
```

Now one is added to your answer. Let's use the addition block. Put the block «answer» to the left, and write «1» to the right.



Place the block that you've got instead of the word «world».

```

when clicked
go to x: -175 y: -40
show
say Hello! for 2 secs
ask What is your name? and wait
say join join Hi, answer 1 for 2 secs
ask how old are you? and wait
say join I thought answer + 1 for 2 secs

```

Test the program. Input the age «7».



Everything is working correctly. Let's continue doing the dialogue. Add the questions about the lesson.

```

ask how old are you? and wait
say join I thought answer + 1 for 2 secs
ask What lesson is it now? and wait
say join Let's go to the answer for 1 secs
repeat 20
  change x by -20

```

The boy is answering in a bit of a non-English way. He has probably been living in America not for a long time.





Add the question about chips. The following program will come up.

```

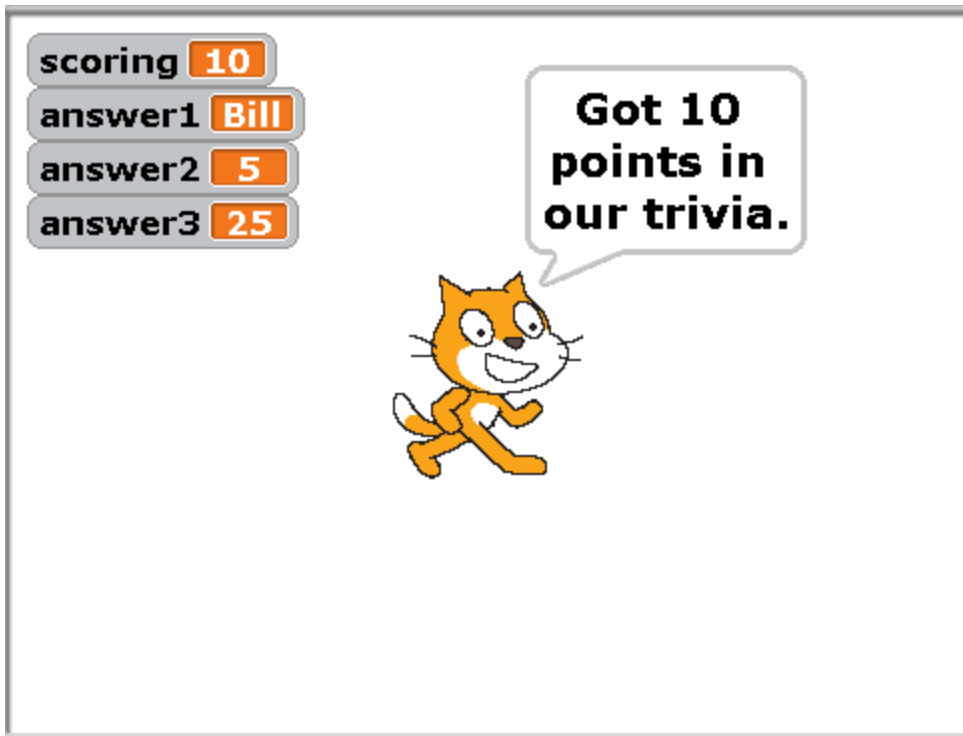
when clicked
go to x: -175 y: -40
show
say Hello! for 2 secs
ask What is your name? and wait
say join join Hi, answer ! for 2 secs
ask how old are you? and wait
say join I thought answer + 1 for 2 secs
ask What lesson is it now? and wait
say join Let's go to the answer for 1 secs
repeat 20
  change x by -20
say Hey, wait. for 2 secs
ask Do you have any chips? and wait
if answer = yes
  repeat 25
    change x by 10
  say Give me some for a bit of crunch! for 2 secs
  say Yummy! for 2 secs
  say Thank you, I am going now. for 2 secs
  repeat 30
    change x by 10
  else
    say Well, this is not my type of a game... for 2 secs
    hide

```

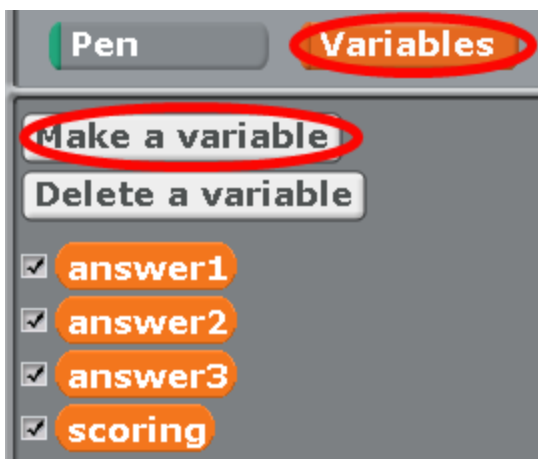
Note that the boy wouldn't go to have a lesson after eating the chips, but would have gone the other way. Change the program so that he would go to school (to the left). You can take away the block «hide» and continue the dialogue further.

**[Chapter 16. «Country capitals» trivia game.](#)**

Let's work with the text a bit more. Let's make a program A Trivia Game.



This program will be using four variables. Create them.



The variable «Points» will store the number of points collected. There are ten questions in the game in total. That means, that the variable «scoring» can change from zero to ten. The variable «answer1» will store the text — the name of the player. The variables will be able to store not only numbers but text as well. The variable «answer2» will also store text — the number of the class where the player studies at. The variable «answer3» will store the text — the number of the player's school. The program is very long, but it contains ten repeating blocks. In order to simplify the work, we will repeat the repeating program pieces. Make the beginning of the program and the first question.

```

when clicked
  set scoring to 0
  say Let's play a trivia game about capitals. for 2 secs
  say Write all the answers with a capital letter. for 2 secs
  ask Ваше имя? and wait
  set answer1 to answer
  ask What grade are you in? and wait
  set answer2 to answer
  ask What school do you go to? and wait
  set answer3 to answer
  ask The capital of The USA is and wait
  if answer = Washington
    change scoring by 1

```

Right-click on the block «ask the Capital of The USA is and wait» and choose «duplicate».

```

set answer3 to answer
ask The capital of The USA is and wait
if answer = Washington
  change scoring by 1

```

help  
duplicate

Attach the new piece to the bottom.

```

set answer3 to answer
ask The capital of The USA is and wait
if answer = Washington
  change scoring by 1
ask The capital of The USA is and wait
if answer = Washington
  change scoring by 1

```

Correct the country to «Canada» and the city to «Ottawa». Make ten questions this way. The first five.

```
set answers to answer
ask The capital of The USA is and wait
if answer = Washington
change scoring by 1
ask The capital of Canada is and wait
if answer = Ottawa
change scoring by 1
ask The capital of Mexico is and wait
if answer = Mexico City
change scoring by 1
ask The capital of Great Britain is and wait
if answer = London
change scoring by 1
ask The capital of Italy is and wait
if answer = Rome
change scoring by 1
```

The second five.

```

ask The capital of France is and wait
if answer = Paris
change scoring by 1
ask The capital of Germany is and wait
if answer = Berlin
change scoring by 1
ask The capital of China is and wait
if answer = Beijing
change scoring by 1
ask The capital of Honduras is and wait
if answer = Tegucigalpa
change scoring by 1
ask The capital of Russia is and wait
if answer = Moscow
change scoring by 1

```

Add several more blocks after the last question. The Cat will announce the results of the trivia game.

```

ask The capital of Russia is and wait
if answer = Moscow
change scoring by 1
say Attention! for 2 secs
say join join Grade answer2 student for 2 secs
say join School No. answer3 for 2 secs
say answer1 for 2 secs
say join join Got scoring points in our trivia. for 10 secs
stop script

```

Start it and show to parents and friends. I don't think that a lot of them know the capital of Honduras! Now you can change the questions to your own questions. For example, from biology, from sports, from the history of your family, from American history.

## Chapter 17. A platformer game.

Let's make the simplest platformer. The Cat is running home through three screens. If the Cat falls into red lava, the game will end.

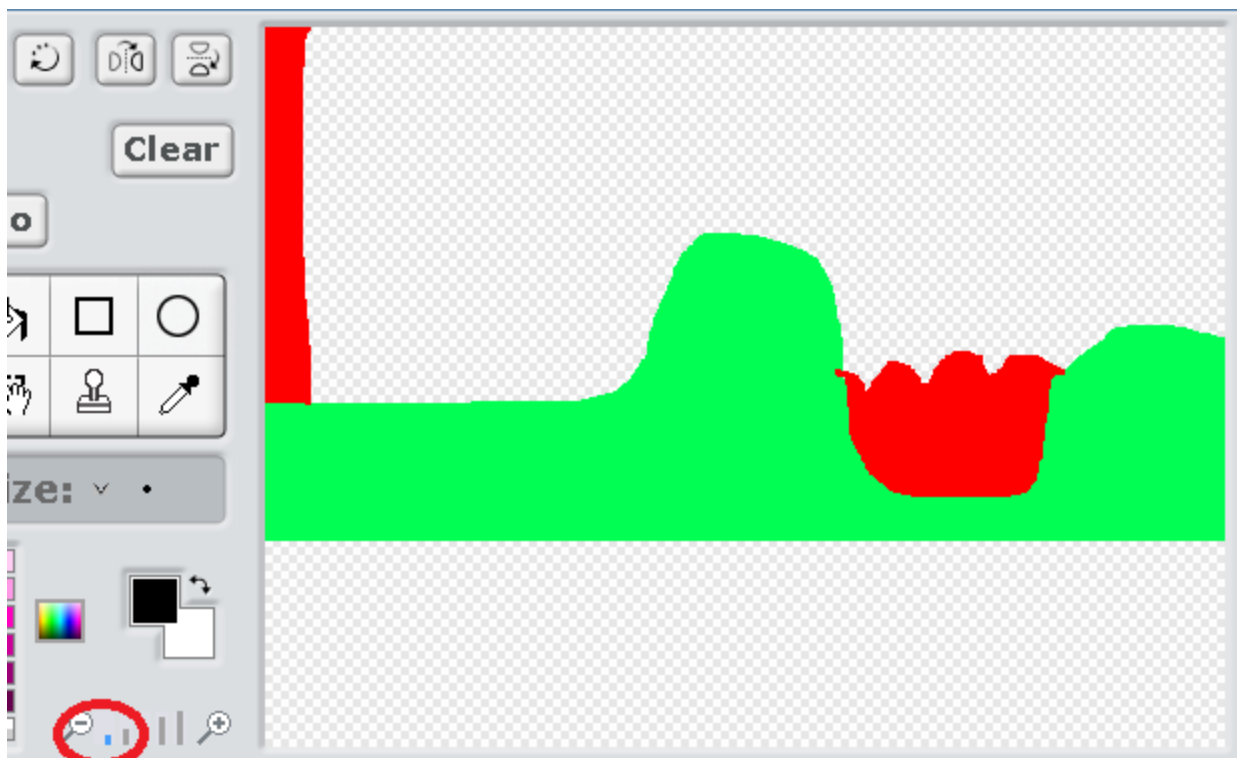


Here, the background is filled with light blue and there is the Sun drawn on it, and the Earth and lava are drawn as separate sprites. The Cat is always in the center of the screen and moves up and down. The sprites with soil and lava move right to left and it seems to the player that the Cat runs to the right.

First, draw the background.

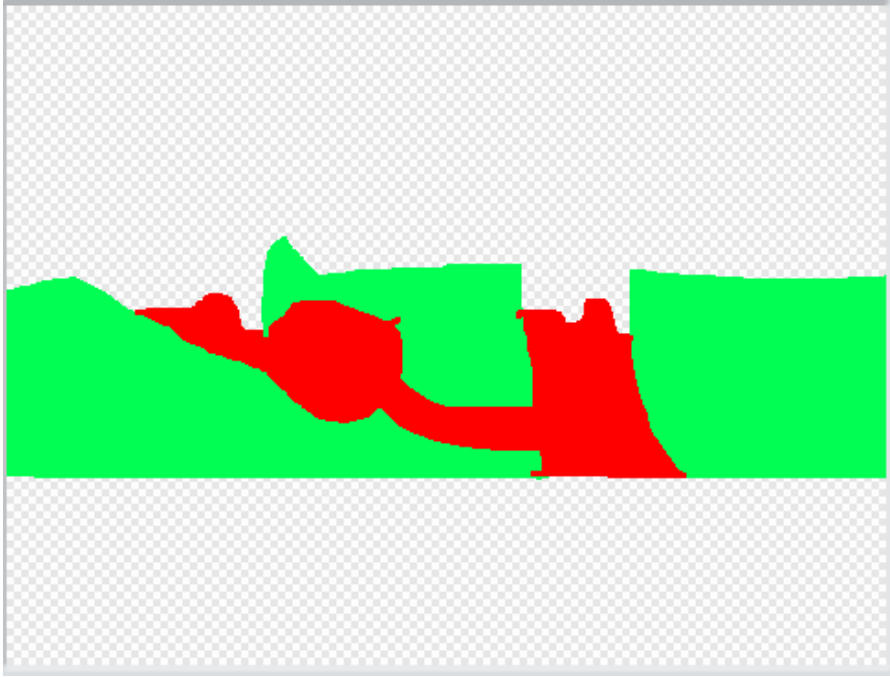


Then draw 4 sprites with soil and lava. Try not to make the areas with lava too wide. Note that we are drawing on the minimal scale. Draw Screen1 sprite.

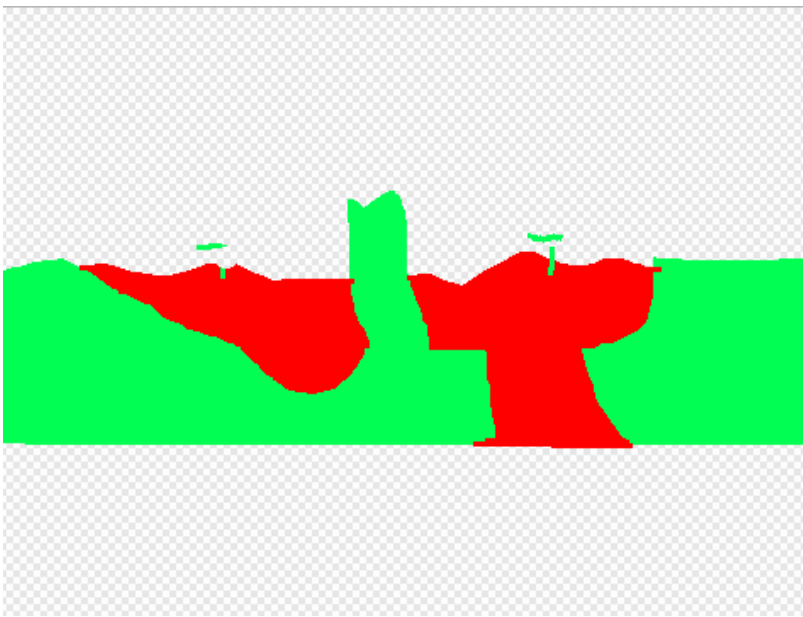


Draw Screen2 sprite.

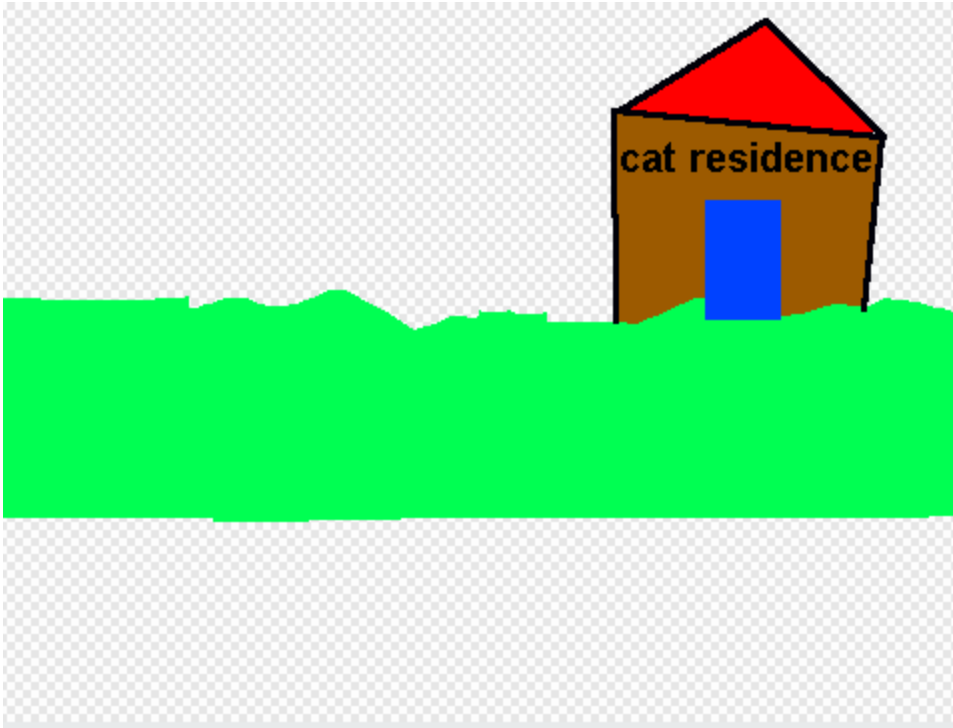




Draw Screen3 sprite.



Draw Screen4 sprite.



Make the following program for the Cat.

```

when green flag clicked
  go to x: 0 y: 15
  set scrollX to 0
  say Where is my house? for 2 secs
  forever
    if key up arrow pressed?
      if touching color green?
        repeat 15
          change y by 8
    if touching color green?
      change y by 2
    else
      change y by -3
    if touching color red?
      say Ouch! for 2 secs
      stop all
    if touching color blue?
      say I am home! for 2 secs
    if key left arrow pressed?
      change scrollX by 2
      go to front
  
```

Let's look in detail how this program works. This will help you to find and correct the errors and to make the program work. At first, when the flag is clicked, the Cat walks to the center of the screen to point (0;15). The variable scrollX is zeroed. This variable shows what distance to the right the Cat walked. It says a sad phrase and then the main program starts in the block «forever».

```
when clicked
go to x: 0 y: 15
set scrollX to 0
say where is my house? for 2 secs
forever
```

The main program consists of six «if» conditions. The first condition is responsible for the Cat's flight up. We change y by eight fifteen times, that is, the Cat will go up by 120 points. But this will only happen if the arrow up is pressed, and the Cat is standing on green ground (is touching the green color).

```
if key up arrow pressed?
if touching color green?
repeat 15
change y by 8
```

The next block is responsible for the Cat standing on the green color and not flying either up or down. If he touches the green, then it will jump 2 points up. If he is hanging over the green color, and is not touching it, he will fall 3 points down.

```
if touching color green?
change y by 2
else
change y by -3
```

This block is responsible for the lava. If the Cat touches the red color, it dies.

```
if touching color red?
say Ouch! for 2 secs
stop all
```

Everything is very simple here. The Cat's house is drawn in blue. If the Cat touches the blue color, it is at home.

```
if touching color blue?
say I am home! for 2 secs
```

The next block describes the movement to the left. The variable scrollX changes by two, the screen movement is attached to this variable. To move left we usually change x to a negative number (to -1, -10), but in our game it is not the Cat but the background is moving. Therefore, in order for the Cat to seem to be moving left, the background has to be moving right. The Cat also moves to the top layer to hide behind the sprites screen1, screen2 and others.

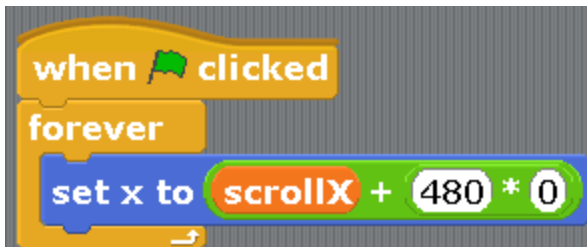


Cat movement to the right is programmed a similar way. In reality, that is the movement of the background to the left.

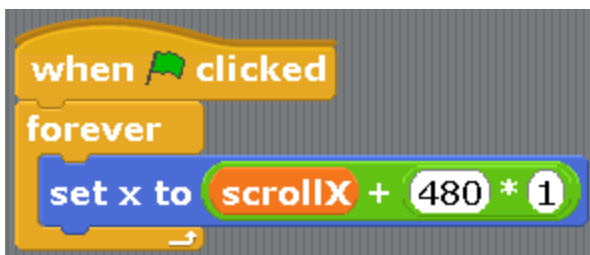


Note: inside the block «forever» all these blocks «if» can be switched in places randomly. The work of the program will not change from this.

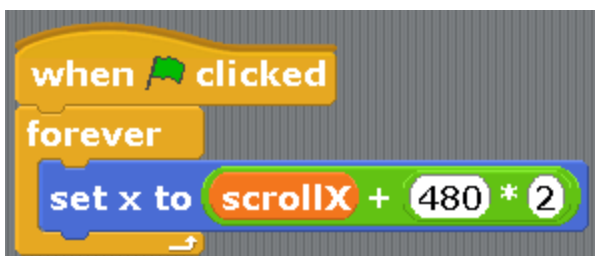
Now let us make programs for the screens. They are all similar. When you make a program for the first screen, drag it on screen2, and it will be duplicated in it. You will only need to change one number. The script for screen1.



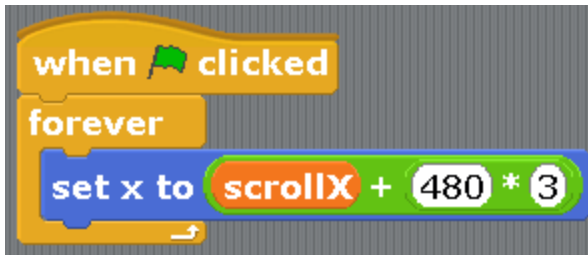
The script for screen2.



The script for screen3.



The script for screen4.



I don't even know myself how these scripts work. I only see one familiar number four hundred and eighty, and that is the width of the screen. When the program is working, watch the value of the variable scrollX and try to calculate the value of the expression scroll+480\*0, then you will understand where screen1 is going to move to. Calculate the expression scroll+480\*1, and you will understand where screen2 will be at. You can try to draw screen5 and screen6 yourself and make the game longer.

### Chapter 18. Cat bowling.

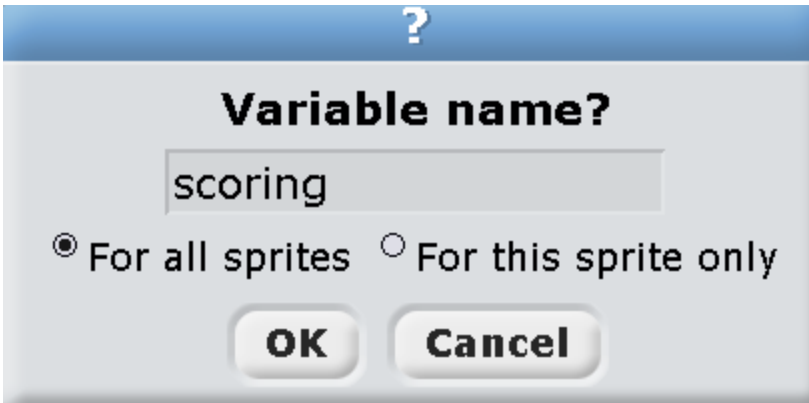
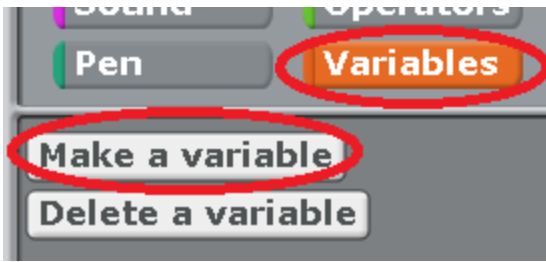
There are a lot of cats in the yard now. Let's play cat bowling! Let's click on the screen with a mouse — the ball is going in this direction. We need to hit all of the cats. When they are struck with a ball, they disappear. In the end, the referee will announce the time of the game.



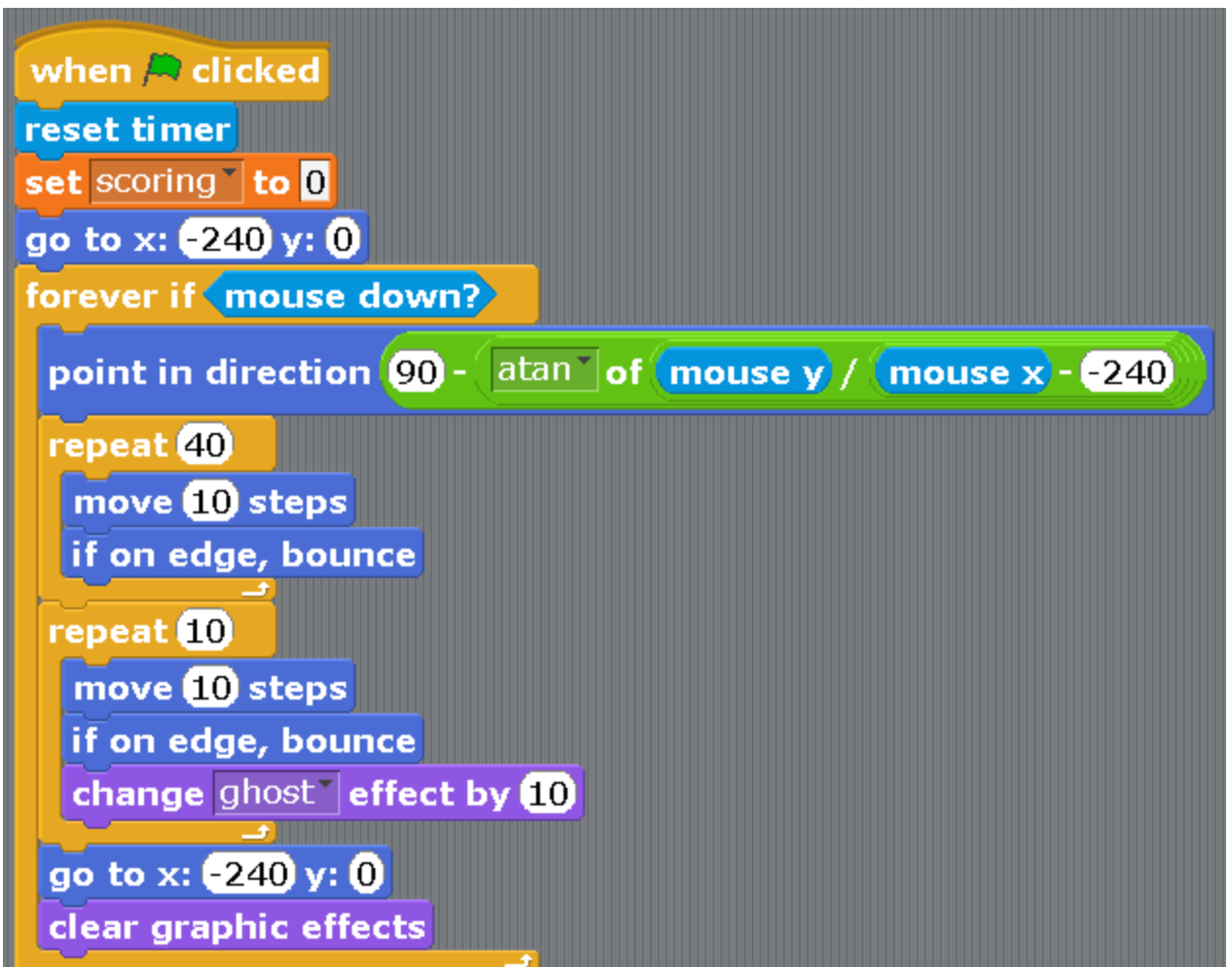
Create a new project. Delete Sprite1 Cat. Add the sprites of the Ball, the Referee and one cat. Rename the Ball and the Referee.



Now create one variable for the Ball.



Make the following program for the Ball.



Here we are using a mathematical function of the arctangent. It shows the direction in degrees to the point where you clicked in. You will learn more at school or in our second book. You also need to put this complex formula step by step. First, drag the blocks that you need into the working area. The block «turn in

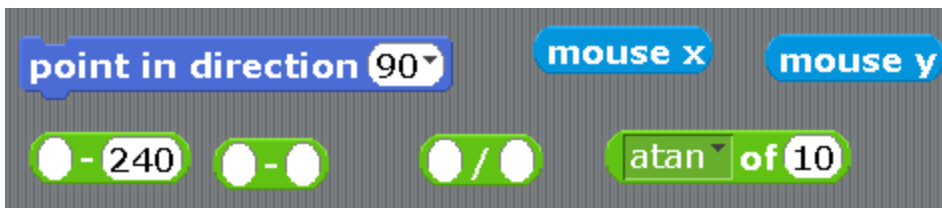
the direction», the block «mouse on x», the block «mouse on y», two blocks with the minus sign, the block of subtraction and the block «sqrt » (square root).



Click on the triangle at the square root and choose «atan». Note how many interesting mathematical functions are available! We will be able to use them to draw cool designs and make a lot of interesting games.



All the blocks are ready to put a formula together.



First choose the first subtraction.



Then choose division.



Add division into the arctangent.





Add arctangent into the subtraction.



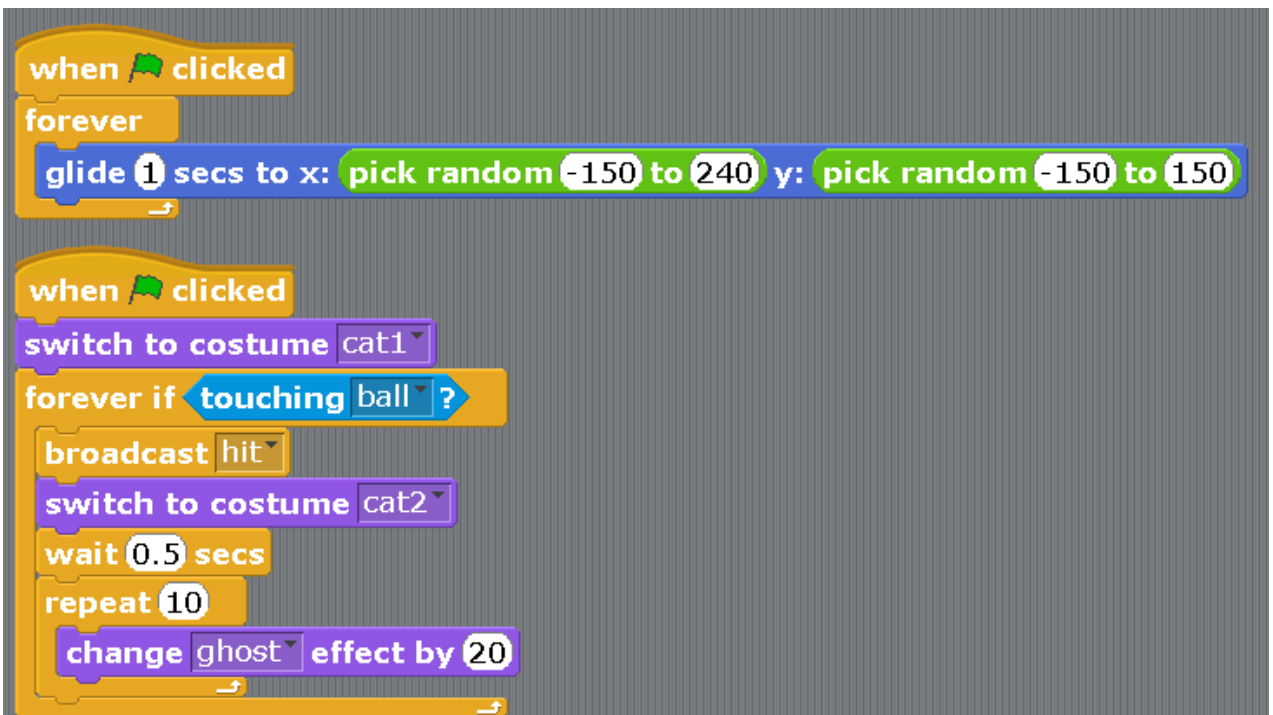
The formula that you get add into the block «turn into the direction».



You have got a cool thick formula, and the main thing is that it works!



Make a program for the Cat. It is very simple. The cat is swimming to a random spot every time.



When the Cat's program is ready, right-click on him and copy it. Create five copies of the cat. You could even create more. Create a program for the Referee.

```

when clicked
hide
go to x: -100 y: 0
forever
if scoring = 5
show
say join join You finished the game in timer seconds. for 10 secs
stop script
when I receive hit
change scoring by 1

```

Test the program.



The Ball is very big. It is very easy to hit the cats. Make the Ball smaller and it will be more interesting to play.

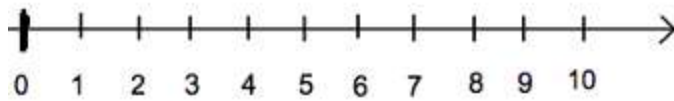


Try to slow the Ball's movement down, it will be even more difficult to play. Insert the block «wait 0.1 seconds» or «wait 0.05 seconds» where you need it.

[Appendix 1. Negative numbers.](#)

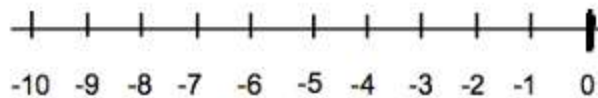
You all know how to count and you know that numbers go in order. Each next number is bigger than the previous number. That is why it is possible to write down all of the numbers in a row and draw a straight line next to them. That is a number line.

The number line is a straight line that has all of the numbers written on it, from 0 to the end of the paper. In reality, the number line is endless. If you in your mind continue the line beyond the limits of the paper, it will have numbers like 100 (a hundred), 1000 (a thousand), 1000000 (a million), 1000000000 (a billion) and even bigger on it.



The number line is very similar to a ruler. If we draw the numbers in one centimeter from one another, we will be able to measure something.

All the numbers on this number line are over zero. These numbers are called «positive» numbers. They only cause you to have positive emotions. For example, two watermelons, three peaches, five chocolates. There are also «negative» numbers. These are numbers with the «minus» sign.



They go from zero to the left till the end of the paper and they keep going. There can be numbers like -100, -1000, -1000000. Negative numbers cause negative emotions. For example, if I give you minus three peaches that will mean that I will take away three peaches from you.

Negative numbers are usually written in parentheses. Here are a few examples.

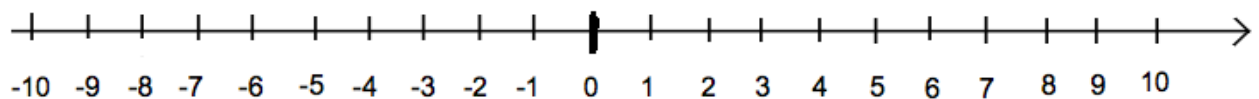
$$1+(-1)=0$$

$$5+(-2)=3$$

$$(-10)+(-10)=(-20)$$

$$5+(-10)=(-5)$$

Here is the whole number line.



If we add a positive number, we move to the right on the number line.  $2+2=4$ . 4 is more to the right than 2. If we add a negative number, we are moving to the left on the number line.  $4+(-8)=(-4)$ . (-4) is more to the left than 4.

Negative numbers are very often used in making games. Any movement to the left is a negative number.



Movement to the right is a positive number.

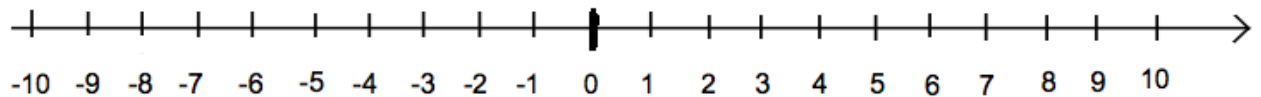


Make these programs and click on the space bar. You will see where the Cat will go to.

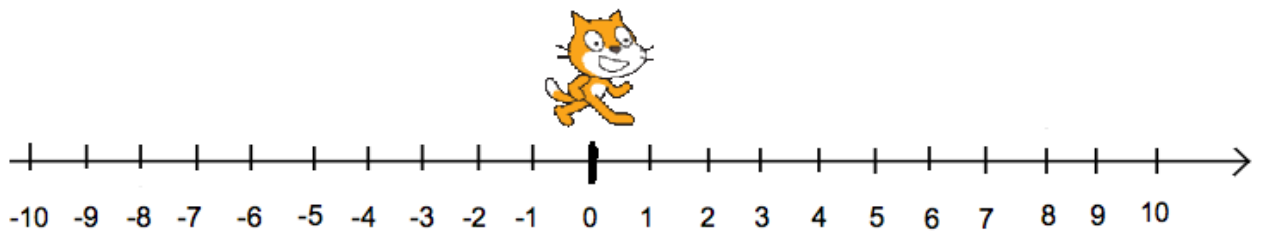
### Appendix 2. X and Y coordinates.

The number line is a straight line where all the numbers starting from 0 are written on.

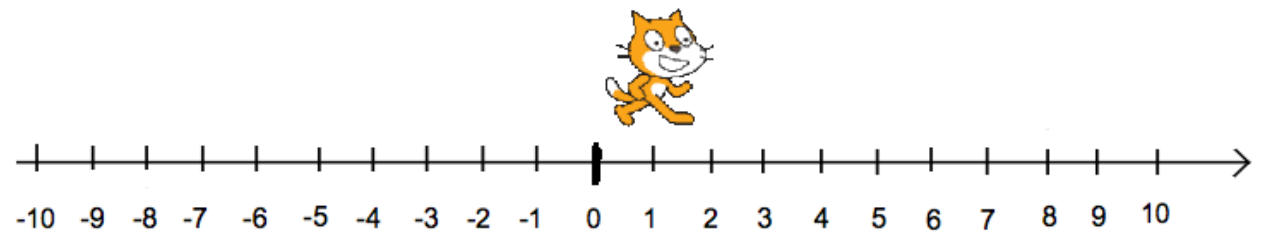
The horizontal number line is x axis.



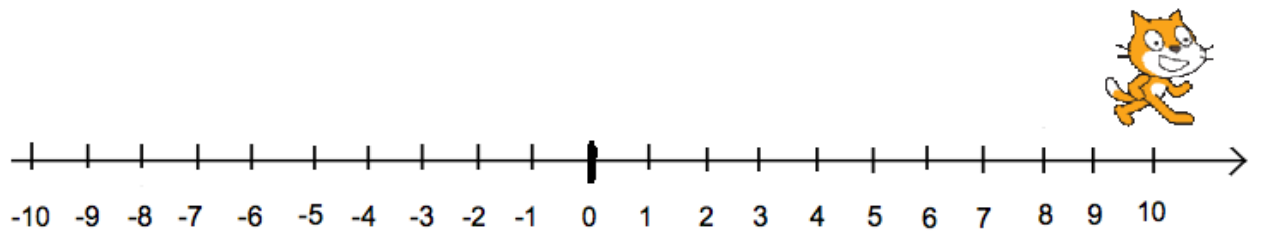
X coordinate of the Cat is equal to zero.  $x = 0$



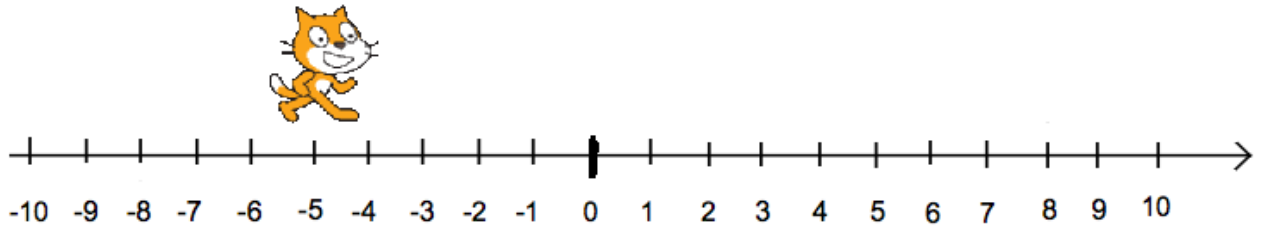
X coordinate of the Cat is equal to one.  $x = 1$



X coordinate of the Cat is equal to ten.  $x = 10$



X coordinate of the Cat is equal to minus five.  $x = -5$



Positive numbers start at zero and increase to the right.

Negative numbers also start at zero and increase to the left.

That means, that if we write «change x by 1» in the program, the character is moving to the right.

```
change x by 1
```

If we write «change x by -1» in the program, the character is moving to the left.

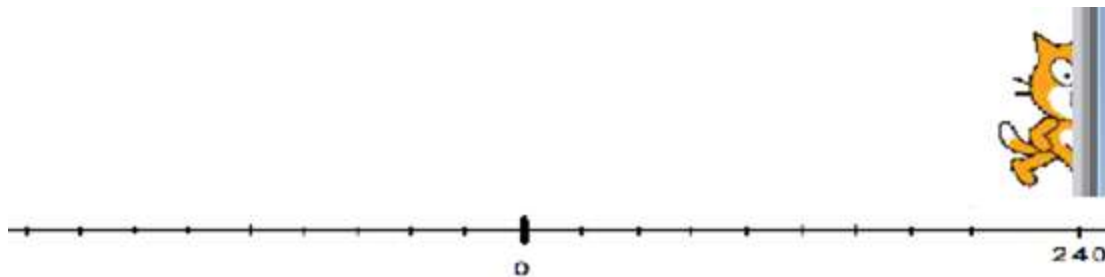
```
change x by -1
```

X coordinate is responsible for moving to the right and to the left.

The extreme points on the screen are  $x=-240$  to the left and  $x=240$  to the right.

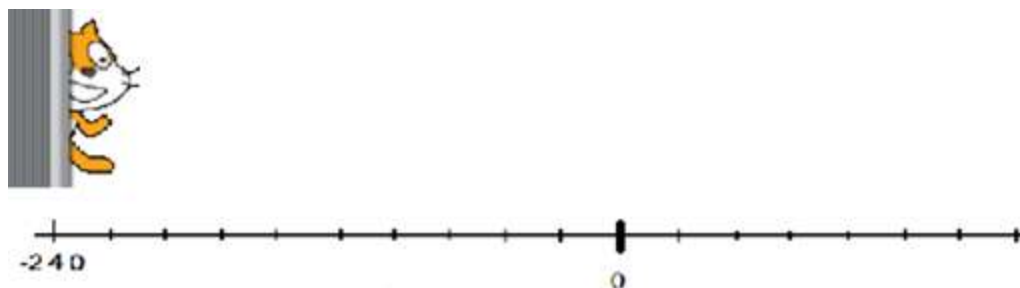
If we send the Cat to the side of the screen with the block «go to  $x=240$   $y=0$ », the Cat will partially hide behind the limit of the screen to the right.

```
go to x: 240 y: 0
```



If we send the Cat to  $x=-240$ , only half of the Cat will be sticking out on the left.

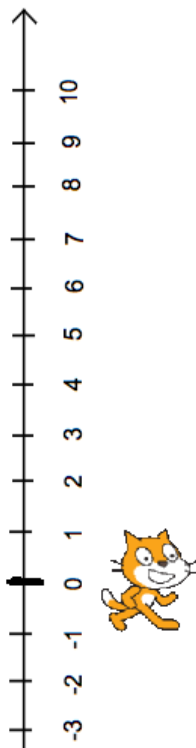
```
go to x: -240 y: 0
```



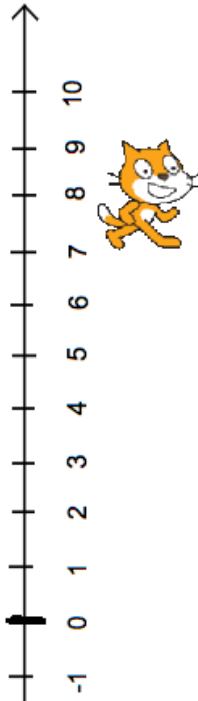
The vertical number line is y axis.



Y coordinate of the Cat is equal to zero.  $y = 0$



Y coordinate of the Cat is equal to eight.  $y = 8$



Positive numbers start at zero and increase up the line.

Negative numbers also start at zero and increase down the line.

That means that if we write «change y by 1» in the program, the character moves up.

**change y by 1**

If we write «change y by -1» in the program, the character moves down.

**change y by -1**

Y coordinate is responsible for the movement up and down.

The extreme points on the screen are  $y=-180$  at the bottom and  $y=180$  at the top.

If we send the Cat to the side of the screen with a block «go to  $x=0$   $y=180$ », the Cat will be half-hidden at the top of the screen.

**go to x: 0 y: 180**



The block «go to  $x=0$   $y=-180$ » will make the Cat half-hide behind the bottom of the screen. We will only see his whiskers.

**go to x: 0 y: -180**



If we change both x and y at the same time, we can send the cat to any part of the screen. For example, to the top right corner «go to x=180 y=120».

go to x: 180 y: 120



Left bottom corner «go to x=-180 y=-120»

go to x: -180 y: -120

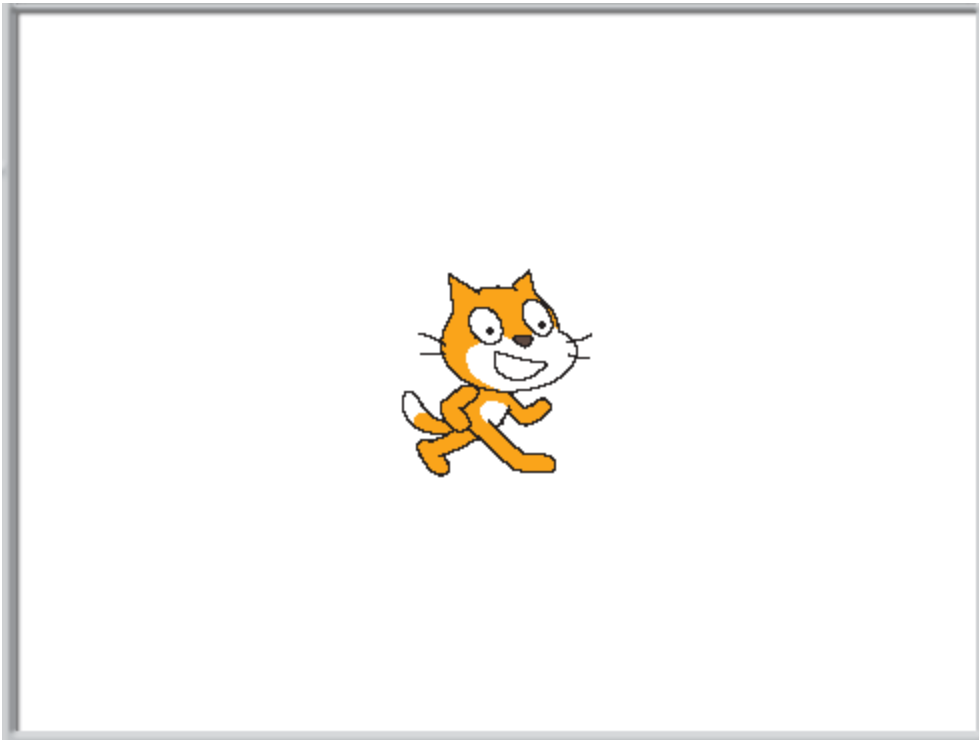


We can always determine what part of the screen the character is in.



Now  $x=0$  and  $y=0$ , that means that the cat is in the center of the screen.





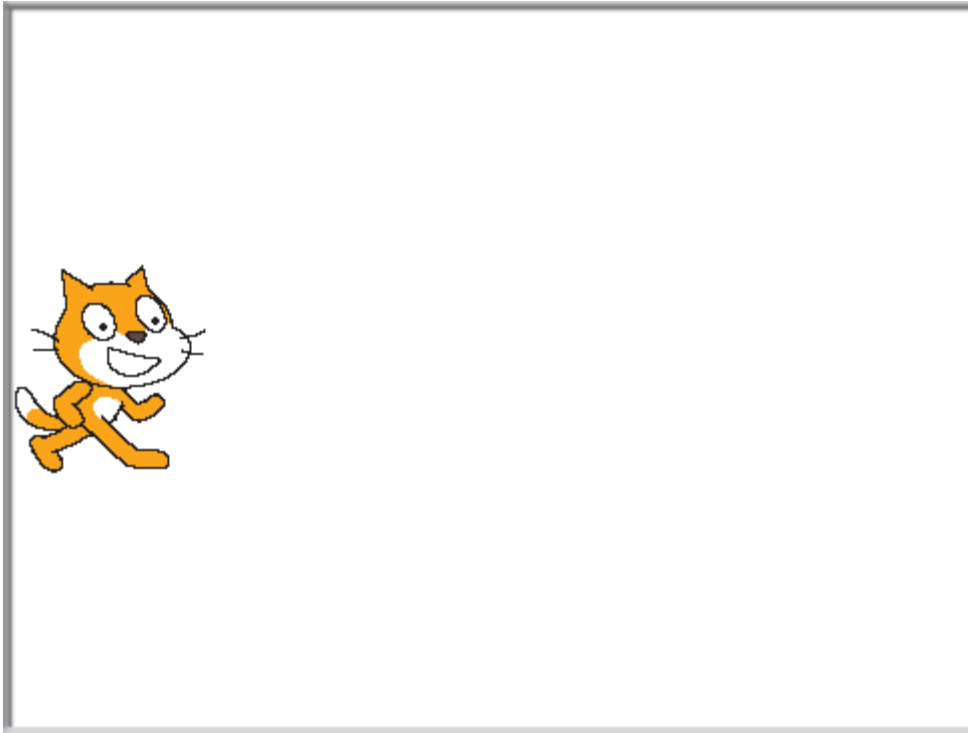
Now  $x=190$  and  $y=0$ . The Cat is to the right.



Now  $x=-190$  and  $y=0$ . The Cat is to the left.

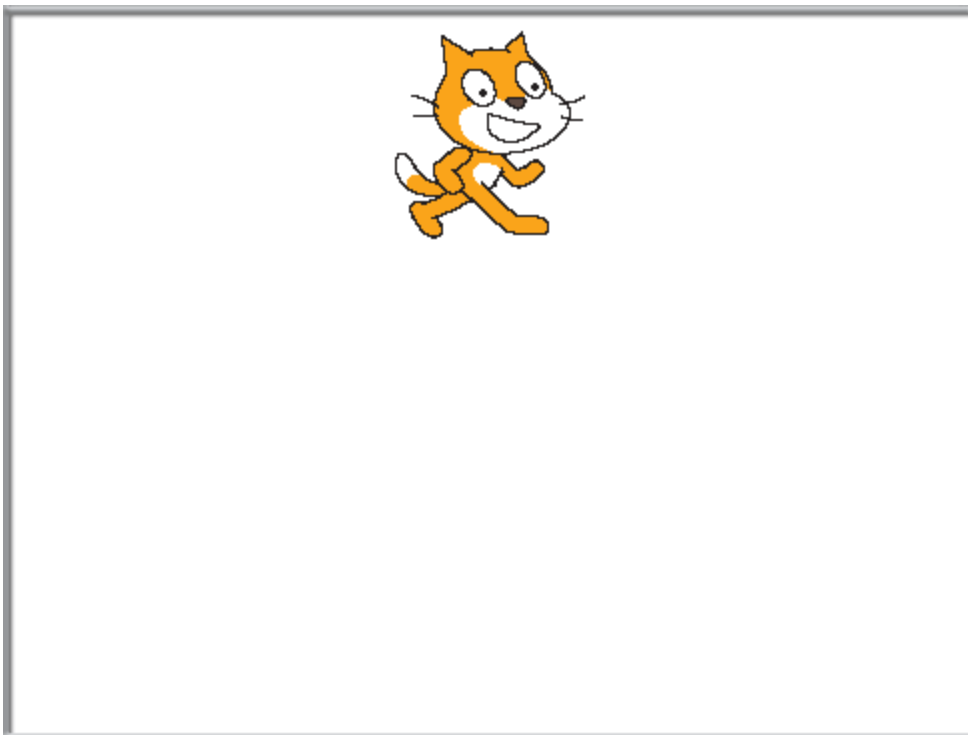
Sprite1  x: -190 y: 0 direction: 90

Scripts Costumes Sounds



Now  $x=0$  and  $y=120$ . The Cat is at the top.

go to x: 0 y: 120

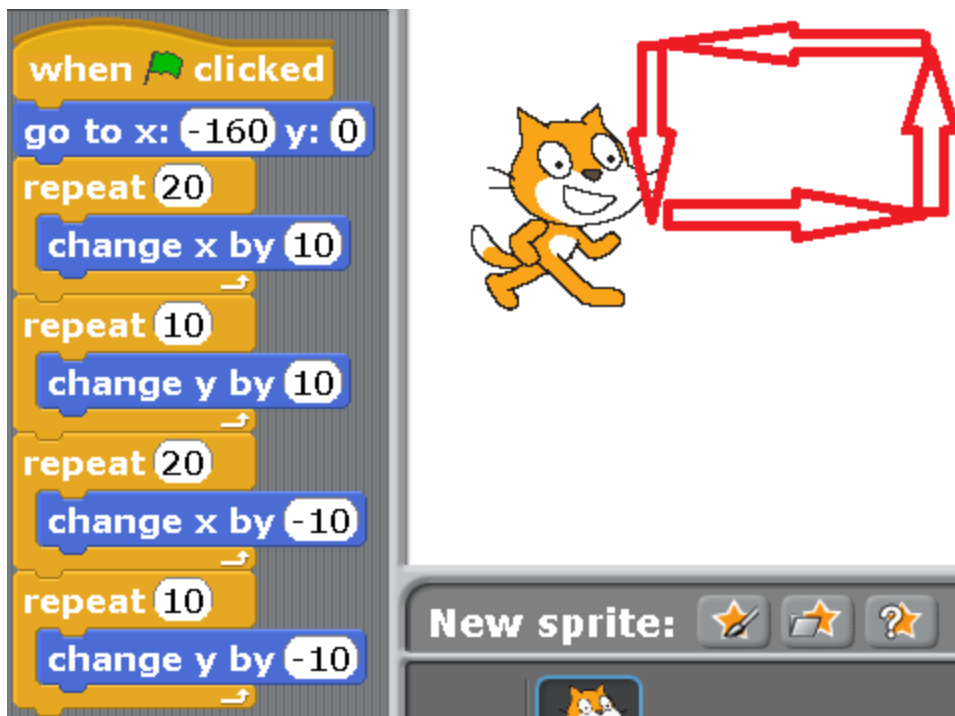


The current coordinates of the mouse cursor can be seen under the window to the right. When the mouse is moving, numbers x and y are constantly changing.



Try to place the mouse exactly at the point  $x=0$   $y=0$ .

Examples of using coordinates. The Cat will be going on a rectangular trajectory.



If we change x and y at the same time, the Cat will be moving diagonally.

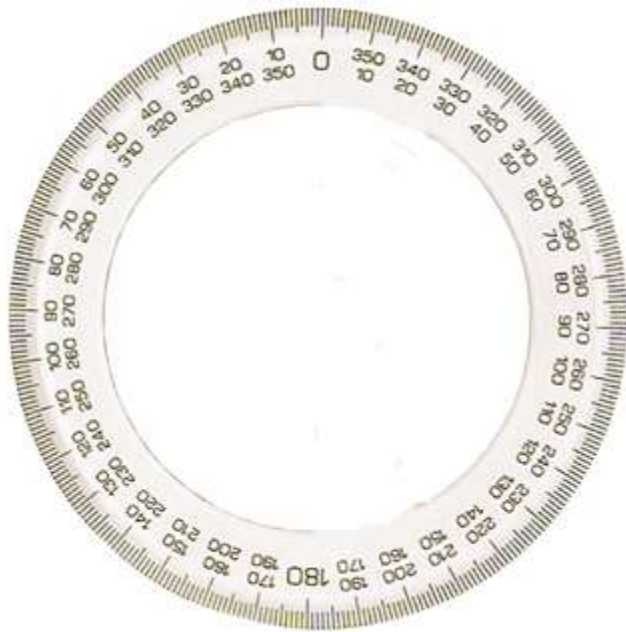


### Appendix 3. Degrees.

You are all familiar with clocks. A clock dial is divided into 12 parts.



At the top it is 0 o'clock, or 12 o'clock. To the right it is 3 o'clock. At the bottom it is 6 o'clock. To the left it is 9 o'clock. In Maths a circle is divided in a similar way into 360 degrees. Look at the bottom row of numbers. The top row of numbers are negative degrees..



In Scratch, like in Maths, a circle has 360 degrees.

The direction of 0 degrees is up.

The direction of 90 degrees is to the right.

The direction of -90 degrees is to the left.

The direction of 180 degrees is down.

If you carefully look at the picture, you will see that -90 degrees is equal to 270 degrees, and 180 degrees is equal to -180 degrees.

Note that on x axis 180 is not equal to -180! 180 is on the right, and -180 is on the left. On a circle, 180 is backwards and -180 is also backwards.

The direction of the Sprite movement can always be seen at the top of the screen.



Let us make several pictures of the Cat for memory in different directions.

The Cat in the direction of 90 degrees.



The Cat in the direction of 0 degrees.



The Cat in the direction of -90 degrees.



The Cat in the direction of 180 degrees.



The Cat in the direction of 45 degrees.



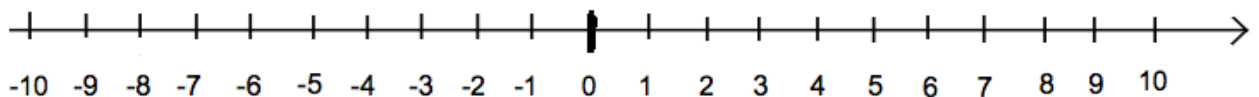
The Cat in the direction of 135 degrees.



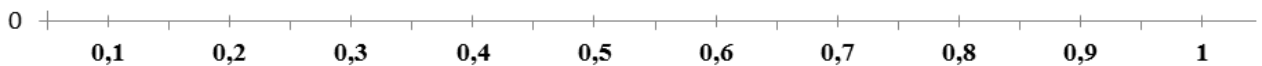
In soccer coaches often yell, «The ball at 3 o'clock!», this means to the right. «The ball at 9 o'clock!», that means to the left. And what does «The ball at 6 o'clock» mean?

#### [Appendix 4. Numbers with a point.](#)

You have already seen a number line in Appendix 2. The numbers are going from zero to infinity to the right and from zero to infinity to the left (negative numbers).

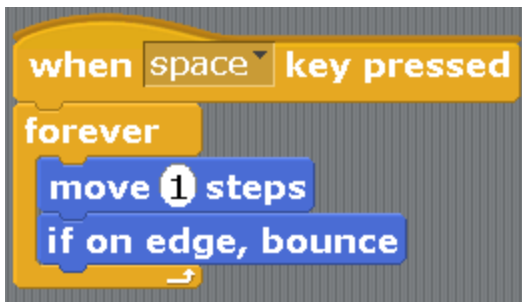


If we put the number line closer and look at it more carefully, we will notice that there are fractional numbers between whole numbers 0, 1, 3 and so on. For example, 9 fractional numbers fit between zero and one. They are very similar to simple numbers, only they are 10 times smaller. For example, 0.1 is 10 times smaller than 1.

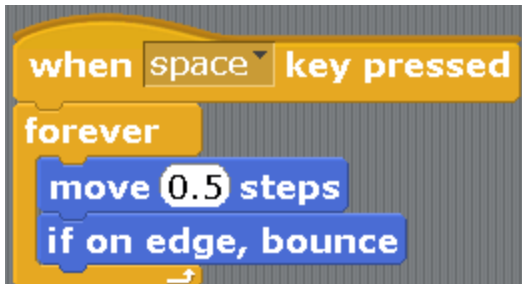


This can be used in order to slow down the character's movement.

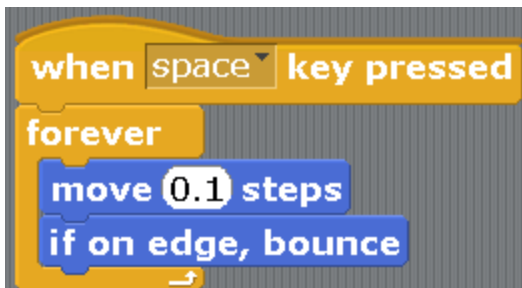
Make the following program for the Cat.



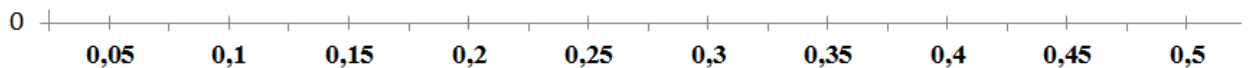
Press on the space bar. The Cat is moving slowly. How can we make him move even slower? Change 1 to 0.5. It is moving 2 times slower.



Change 0.5 to 0.1. It is moving 5 times slower.



If we move the number line even closer, even smaller numbers will appear.



We can mathematically write it down as  $1/2=0.5$   $1/4=0.25$   $1/10=0.1$

5 is two times smaller than one, 0.25 is four times smaller than one, 0.1 is ten times smaller than one.

We will very often use fractions in our programs.

### [Appendix 5. A floppy disk.](#)

You need to click on the floppy disk in all of the programs to save your work.



Joking aside, in reality, a floppy disk is an old flash card.



The amount of memory in a modern flash card is 4 Gigabytes or 8 Gigabytes. In other words, it is 4000 Megabytes or 8000 Megabytes.



The volume of a floppy disk memory is 1 Megabyte in total!

That is, instead of one flash card you would need to carry 4000 floppy disks in your pocket!

4000 floppy disks weigh 100 kilos! I wouldn't be able to carry that.

#### [Appendix 6. The true story of the Cat and the Flying Dog.](#)



Once upon a time, on a hot January afternoon, a scaredy Cat-professor was walking along the Sahara desert. He was afraid of everything in the world except for small, nice and fluffy spiders bird-eaters. He was looking for their burrows in this desert in order to give them gifts for Christmas. The day was very hot, and the Cat-professor wanted to take off his fur-coat very much but he couldn't find the buttons or even the zipper at all. All of a sudden, a bat with long dog-like muzzle (also known as flying dog) appeared and screamed, «I will eat you up!» and dashed towards the Cat. «A Dooooog!» screamed the scaredy Cat in panic. «Even though it is a flying dog, it is still a dog!» Fortunately, he always carried a jet-propelled backpack with him with the MGJP system. «Bye», said the Cat and pressed the Start button forcefully. In a



second, the Cat was so high it was impossible to reach him, and he only noticed the collar of the flying dog through the corner of his eyes. The collar said *Rousettus aegyptiacus*. «That is an Egyptian type of fruit bats! They only eat fruits, and their favorite fruits are bananas!», went through the Cat-professor's head. Having flown away to a safe distance, the Cat turned and saw bunches of burnt bananas. He touched ripe banana bunches with the fire from his jet-propelled backpack. «My dinner!» screamed the flying dog sobbing broken-heartedly. This evening the flying dog didn't have her traditional supper of bananas, and she flew to look for a shovel to dig up baked potatoes in the desert.



«You can meet anybody in this desert» thought the Cat and went on to look for his favorite spiders. When the spiders got their gifts, they were very happy.



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